FARMING WITHOUT CHEMICALS

The Organic Farmer

JUNE, 1950
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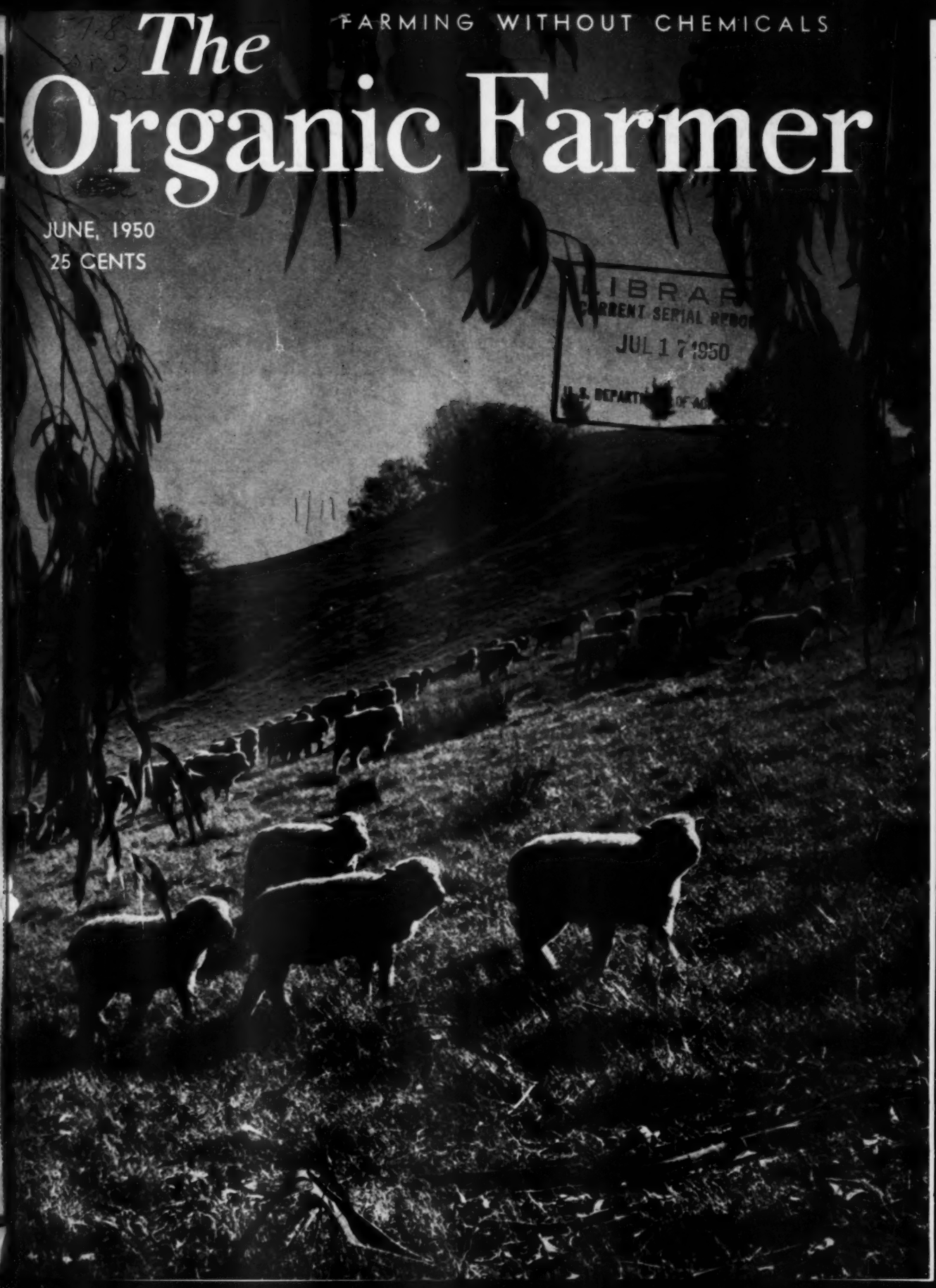

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EMMAUS, PENNSYLVANIA

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June, 1950

The Organic Farmer

Farming Without Chemicals

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Cover: Sheep grazing in the San Fernando Valley in California. Photograph by Ewing Galloway.

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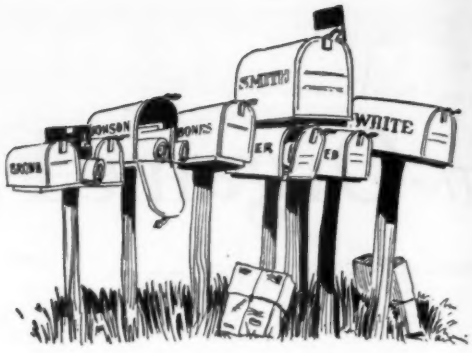
Letters



Need for Experimentation

Dear Sir:

I have been thinking a great deal about how to forward the organic way of farming. Let us go at the problem in this way. Let us not so much attack the effect of chemical fertilizers and sprays, but re-establish that which is the best way, the organic way.

Let us give farmers a method that is better and more desirable than the techniques they are now using. Let us continue to show them, by scientifically tried methods, that yields can be increased by the organic method. Use test plots, both small and field scale. Let us publish the results of the trials, showing what was used in the way of soil, seed and treatment, with analyses of fertilizers, composts and manures used. Show the resultant yields. And, most important, show the quality of the product by an analysis giving mineral and vitamin content. I think it would be good to establish plots treated chemically, organically and with no treatment at all, this last being the check plot.

Let us show that erosion can be checked, by presenting actual tests of run-off plots, using the organic method.

I often wish I had a farm where I might carry out just such tests as I have mentioned so that I could pass on the knowledge gained. Perhaps you will remember that I visited your farm several years ago and that I am a Conservation Aid and deeply interested in the soil and its proper use.

Christopher O. Flanagan
Hamburg, New Jersey

The Soil and Health Foundation has almost completed setting up a series of test plots similar to those suggested by Mr. Flanagan. They will be maintained for many years and the results of tests conducted on them will be reported in The Organic Farmer.

Dear Sir:

I wish to compliment you again on a generally fine magazine and on your large percentage of articles on farming in general as well as just your specialty. I find more articles that actually tell what to do, or just what was done, than I find in publications with several times the mass.

William L. Selden
Rush, N. Y.

Dear Sir:

On page 26 of the April *Organic Farmer* there is an article entitled LEGUMES which has something to say about Ladino clover. As this article was written by a man from Vermont I hardly think he is familiar with California conditions. And so far as I know Ladino is not too largely used in northeastern U. S.

Here in California Ladino is being planted by the thousands of acres. Its chief use is for pasture. It is shallow rooted and requires frequent irrigation. The length of time that it will last depends on the management of the pasture. When fed down it comes back quickly and and if not fed off too closely the runners cover the ground. There are some fields of Ladino in this district which have been carrying cattle continuously for five years, but they are improving with age. Ladino has been the salvation of the dairy industry here.

I have written this to supplement the above article as it looks as if the writer was not fully informed on Ladino in this end of the country.

Edgar E. Burnet
Lincoln, California

Dear Sir:

I would like to take this opportunity to tell you that out of all the magazines and books related to the subject of farming that I have read, yours is far and away the tops of

them all. For a person with a limited knowledge of farming such as my own it is the most educational literature I have found.

R. G. H. Knight, Jr.
Somerset, Mass.

Dear Sir:

We are pretty much novices at farming in this section, trying to get started and make up our minds about the proper procedure to follow.

IF we could phosphate our land with ONE application of colloidal or rock phosphate and supply potash with ONE application of potash of a lasting nature, we could eliminate a great deal of expense.

We realize that the land will have to be treated from time to time with whatever we use, but we want to use something that will stick with us for more than a few months and not have adverse effects on the soil at the same time. We have not been aided in this respect by the agents in this area. To them it's always superphosphate and chemical fertilizers.

In spite of our muddling along we have made great strides. Fields that for years raised just a little more corn than it took to feed the mules that worked them, year after year with no rotation, are now in lupine and indigo or in clover and grasses that will carry our stock through the whole winter.

Cattle that used to be thin as snakes are now coming through the winter to drop sturdy calves and breed shortly after. A hundred head of breeding cows now produce 75 calves against the 35 they used to drop on the piney woods range. We have the land and the climate to raise cattle down here, but we don't want to ruin our land while we are doing it.

Robert W. Ferguson
Fernandina, Florida

Queries and Comment

Lodging Corn

Dear Sir:

My problem concerns fallen down corn. For three years hence, my field corn has produced 70 to 90 bushels per acre, but has fallen flat at maturity or after. The stalks have short, small roots. During this past winter my daughter and I picked up over 1000 bushels, so you can see that we had our time occupied.

Emil S. Hageman
Lebanon, Illinois

One farmer we know gets around the problem of lodging corn by planting his seed extra deep. Why not try that procedure on part of your corn acreage? John Moyer, a farmer who has an article in this issue, has prevented the lodging of

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BENSON-MACLEAN
Bridgeton 22, Indiana

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corn by switching to the open pollinated *variety. That may seem like walking into the lion's mouth, but he has found it to pay. Because he can use his own seed year after year, he can, by observing and marking the best stalks, select only that seed capable of producing lodge-proof plants* on his own land. *The result has been that he has taken corn that used to lodge severely and "converted" it into the firmest-stalked corn in his neighborhood.*

Mildew on Grapes

Dear Sir:

Please tell me if there is anything besides sulphur on the market that I can use to spray my green grapes for mildew. We lost the grapes two years ago when they were not sprayed with this stuff, but the sulphur from the spray burns my stomach and I can not use the grapes for myself.

Lucyellen Putney
Van Nuys, California

Mildew on grape vines may be largely controlled by proper pruning and supporting of the vines. Mildew is a fungus disease and is most active when the atmosphere is moist. If, through the above mentioned practice, proper air circulation is maintained around the leaves and fruit, mildew will not be a serious problem. Application of liberal quantities of organic matter to the soil will increase the health and vigor of the plants and they will become more resistant to this disease.

Pine Sawdust

Dear Sir:

You have recently published several articles on the use of sawdust mixed with animal urine and manure to be used as fertilizer. Here in Florida there are numerous sources of sawdust. We wonder whether this sawdust, which comes

almost exclusively from the Florida Pine tree, which is high in turpentine and other resins, can be used.

Robert K. Robson
Boynton Beach, Florida

It would not be good to use the pine sawdust in the raw state, but if it is allowed to weather for a period of several months, little damage will occur from the turpentine resins in this material.

Here's How to Get Rid of a Farm

Tired of farming? Want to get rid of your land? Well, here's the recipe:

Cut one medium-sized farm into irregular pieces.

Add several successive cash crops to remove the humus.

Stir the thin layer of topsoil frequently until the soil particles are ready to be carried off by the next hard rain. Carefully work the land up and down the slope so that furrows will form water-ways for rapid disposal of excess water—and soil. Keep doing this until the hardpan shows through on the hilltops and slopes.

Then cut into deep, irregular gullies and leave out in the sun to bake. When done, season with an unpainted house, some old worn-out machinery, broken-down fences, a rickety barn, a good sprinkling of unpaid bills, with a pinch of despair. Garnish with weeds.

Serve with a tax sale and move on.

—New Mexico College of Agriculture

Water Light and Often For More Vegetables

How you water your garden will have a lot to do with the number of plants that live 'til harvest time, says the 1950 Illinois Garden Guide.

Don't water your newly planted seedbed until it absolutely needs it. Then frequent light waterings are better than a heavy watering.

Heavy watering packs the soil just as a hard rain does. Seedlings will have a tough time breaking through the crust formed. And, if you try to break the crust with a

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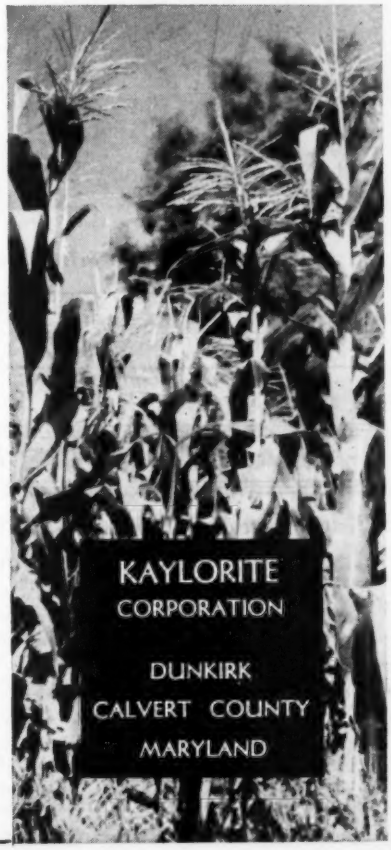

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IT'S SAFE

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rake or hoe, you'll probably damage the seedlings.

Growing plants are your best indicator for watering, says the Garden Guide. Melons, cucumbers, eggplants and similar plants wilt a little on a hot, windy day. But if there is plenty of moisture in the soil, they will revive during the night. A good rule is to water the garden only when those plants do not revive overnight. Then soak it with at least a half-inch of water.

Moisture will evaporate least if you water your garden in the evening. However, daytime watering is better than none at all.

After you water, cultivate the soil as soon as it is dry enough to work. This conserves moisture and prevents weeds from starting to grow.

Polka Dotted Pastures

Hundreds of little catch basins gouged into the surface of some of the western range lands have proved the most economical method of increasing their meat producing capacity, says the U. S. Department of Agriculture. "Pitting" the range is the term the Soil Conservation Service uses for this treatment. Immediately after a rain a "pitted" range has a polka dot appearance with water standing in the little basins.

A modified disc plow with part of the discs set off-center produces the pitting effect. A disc digs into the surface of the range and throws out and scatters the soil. This affects about 30 percent of the surface and leaves small basins ready to catch rainfall and give it a chance to soak into the soil. The basins are about 16 inches apart, and the "pitting" provides storage space for about 1000 cubic feet of water on each acre.

●

The Northern Nut Growers Association is holding its convention August 28, 29 and 30 at Poughkeepsie, New York. One of the field trips of the convention will be a visit to the nursery of Mr. Gilbert H. Smith.

With the Editor

By J. I. Rodale

How Soil Was Formed

IN ORDER to understand how to fertilize a soil it might be a good thing to study how that soil was formed and what it consists of. If we know what it is made up of we can better understand what would be the effect of introducing certain substances into it. The soil consists of organic and inorganic matter. Let us see how they originated.

Organic matter is an extremely important substance and is the basis of all life. The farmer and gardener cannot do without it, for through its use he will obtain healthier plants besides a greater yield of plant matter. Organic matter originates from matter that was once alive, although that was not the case at the beginning of the formation of the earth.

Originally the earth was one mass of rock, there being no plants of any kind or soil. The rock was the parent, the precursor of the soil as we know it today. Through the action of certain agencies part of this rock was transformed into soil. Over millions of years this rock has been "weathering," that is decomposing by the action of heat and cold air, winds, rains, fogs, movement of glaciers, and climatic changes. Professor Albrecht of the University of Missouri recently said, "What is soil after all? It is a temporary rest-stop while the rock is on its way to the sea." That is, the rock gradually forms into soil which is washed by erosion into the bottom of the seas where over a period of millions of years, it will harden again into rock.

Rocks are porous, more so than can be noticed with the naked eye. They therefore absorb water which upon the alternate action of heat and cold with expansion and contraction causes a crumbling and a breaking. Running water and the action of glaciers moving over the rocks soften and grind them. These continuing actions keep grinding, breaking down and disintegrating the rocks into finer and finer powdery masses. The action of the carbonic acid gas which entered the water from the air helped with its acidic solvent action to soften the rock.

Practically none of these rocks contained nitrogen—in fact practically no rocks today contain nitrogen, which is in the air and in the soil. But, in order for plants to grow they must have nitrogen. The rocks contained all the *minerals* needed for plant growth, but nitrogen had to come from the air at the beginning of the process of formation of soil. The air, containing 78 per cent nitrogen, had more than enough for that purpose.

It is important in this study to attempt to understand how the first organic matter might have been created. Science does not know for certain and there are many theories extant about it. It is all tied up with carbon, for carbon is the principle constituent of organic matter. It is certain however, that even before the simplest lichens and mosses could have grown there must have been bacteria or enzymes to aid them, and since the latter consist of organic matter they represent an early existence of life.

But evidently organic matter was in existence before life, for bacteria and enzymes were no doubt created out of organic matter, although it was an inferior dead type. It lacked the living qualities given to it by enzymes, bacteria and fungi. The organic matter no doubt came into existence first, obtaining its carbon from the atmosphere by means of electric and lightning discharges. Eventually enzymes appeared, a crude sort which could not regenerate themselves. Later there were

Ewing Galloway

This weathered rock formation shows how susceptible some rock is to erosion and conversion into soil.

With the Editor

Continued

evolved self-regenerating enzymes, and then bacteria. Millions of years must have passed between each stage from enzyme to self-regenerating enzyme to bacteria.

The evolution of the development of plant life was an elaborate, long-time process, taking millions of years of time. The first types of plant that were able to grow were extremely simple ones, such as the lichens and the mosses that grew on the face of the rocks. The requirements for sustenance were not too great. In helping them to grow, certain bacteria which had already come into existence took a prominent part, feeding upon the minerals that were in the rock and nitrogen from the air. It is certain that bacteria came before the lichens and the mosses. As these lichens and mosses died, their remains were the first source of organic matter, outside, of course, of the tissues of dead bacteria. The remains of such dead lichens and mosses mixed with the minuscule rock fragments, becoming soil. Thus the soil was a mixture of rock particles and organic matter.

Process of Decay

During the process of decay of the lichens and the mosses, certain acid substances were given off such as carbonic acid and other humus acids which worked upon the rock to make more mineral food available for the future plants. The action of air and carbonic acid on the rock particles and on the organic matter turned the substances dark, which is characteristic in the formation of humus. Soon there was sufficient soil so that plants higher up in the scale of plant life could live and by that inexorable process of slow evolution in living matter, a desire upon nature to adjust and to improve, ferns came into existence and could grow. Over millions of years of slow evolution, still higher plants began to evolve such as grasses and shrubs. Finally trees began to grow.

The soil consisted primarily of weathered rock fragments, water, organic matter and dusts which fell upon it from the air. The lightning charged nitrogen into it. The rains washed nitrogen and other elements into it. Soil bacteria extracted nitrogen from the air. But basically you can visualize the soil as being made up mainly of weathered rock particles and organic matter, closely associated and mixed together. Therefore in our farming and gardening we should supply the soil with those same two ingredients, namely finely ground up rock and organic matter.

Soil requires the major elements —nitrogen, phosphorus and potash —besides the minor and the trace mineral elements. They can all be obtained through ground up rocks, except nitrogen, which is furnished through organic matter and by bacteria which extract it from the air. In the organic method, therefore, we have a means of adequately feeding the soil. In the organic method the consideration and the study of rocks assumes great importance because in their use is a safe means of furnishing to the soils minerals in a form which the soil is used to.

Today, however, agricultural science advises that chemical fertilizers which contain other principles beside the above two mentioned classes of substances be added to the soil.

In the rocks the various elements are safely diffused by nature, so that there is no dangerous concentration in one place of substances which may assume the quality of a poison when concentrated in one spot. Acids are sometimes employed in these chemical fertilizers. Wherein, in natural soil, there may be formed the same acids, they are usually present in extremely small quantities. In the case of the trace mineral elements which are required in such small amounts as only 3 or 4 parts per million, it is dangerously easy to oversupply them by indiscriminate application in chemical compound form and damage can result.

In a chemical fertilizer, after the plant takes up what it needs, unneeded residues pile up in the soil,

(*Continued on page* 59)

Soil Fertility and Insect Control

Consideration of plant nutrition is the soundest approach to the insect problem.

By LEONARD HASEMAN

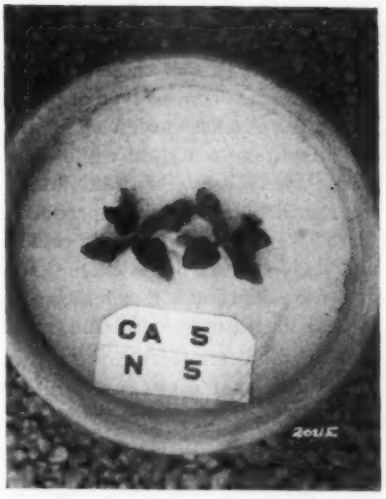
Department of Entomology
University of Missouri

AS AGRICULTURE ages and becomes more intense the general level of soil fertility tends to go down while insect problems tend to go up. Is this merely coincidental or are there good reasons why insect pests should increase as soil fertility goes down? As erosion, leaching and overcropping lower our soil's normal fertility by robbing it of its minerals, humus and other organic matter, we are forced to move from the more demanding and at the same time better soil rebuilding nitrogenous clover crops down through the less demanding beans and lespedezas to the low proteinaceous but high carbohydrate grains and grasses. These crops in turn may tend to step up "soil snatching" where they are sold off the land without returning anything to the ever-decreasing pool of soil fertility.

By entering upon this vicious cycle of soil depletion we turn to the production of food crops increasingly unfit for man and beast but increasingly fit and proper for some of our worst insect pests.

It is a well-established fact that man and the higher animals, in order to escape the ill effects of "hidden hunger" and nutritional deficiency diseases, generally require a well-balanced diet rich in minerals, vitamins and other factors protecting health. Such a diet calls for vegetables, fruits, grains and other plant products grown on fertile soil, and meat and dairy products from animals fed well enriched crops. On the other hand, not all insects require or can utilize well-balanced diets of this type. Some of them, we find, thrive and reproduce better on unbalanced or inferior diets as we think of them. Such being the case it is but natural that these types of insect pests should thrive and increase as depletion of soil fertility requires the growing of less nutritious and less bountiful crops.

In many ways insects are the most wonderful animals on the globe. In number of kinds or species they comprise about four-fifths of all the animals in the world. They are among the most ancient of the common everyday creatures and yet in many ways some of them are the most up-to-date. They had already overrun the earth one hundred or two hundred million years before man's progenitors appeared. They first discovered such more recent human rediscoveries as air transportation, jet propulsion, dive bombers, submarine warfare, stink bombs, smoke screens, gas warfare, biological warfare, anesthesia, ventilation, insulation, armor plate, paper, masonry, dies,



Spinach plants grown on low levels of nitrogen and calcium showing serious damage by greenhouse thrips.

Spinach plants grown on high levels of nitrogen and calcium which were not attacked at all by the greenhouse thrips.

Soil Fertility and Insect Control

Continued

working in wax, engraving, preservation of meat, canning food, slave trade, dairy farming, grain farming, birth control, multiple quintupling, infiltration, socialism and biological world domination.

Insects Surpass Humans In Efficiency

With all these accomplishments and many more it is not surprising that in their millions of years of experience and keen competition they should have become the most capable of all animals in the matter of adjusting their nutritional needs. Some learned to feed on the crumbs from the tables of others, some thrive on the waste of offals from other animals, some feed on their own dead, some thrive on wood pulp and other cellulose by the aid of friendly microorganisms and still others produce their own vitamins or secure them from cooperating microorganisms. It is therefore not surprising that we should find that many of our insect enemies naturally call for and thrive best on what we might consider deficient or inferior diets.

In nature there are abundant illustrations of insect pests choosing and breeding more abundantly on weak and undernourished plants or crops and livestock. Take for instance lice on calves. It is the weak, underfed, and undernourished, rough coated, weaned calves and not those suckling, fat, smooth-coated ones which are often eaten up with lice. Also, a weak, sickly hen in the flock will always carry most of the lice. Again it has been found that female mosquitoes may produce more eggs when it feeds on the blood of one animal than when it feeds on another.

In like manner weakened trees, due to drought, leaky gas mains or loss of roots due to excavation, will always be more heavily attacked by borers than nearby healthy trees of the same kind. Chinch bugs tend to collect and breed more heavily on corn or wheat up on the eroded slopes rather than down at the foot of the slope where the eroded soil minerals and organic matter pile up. In this case it is the high level of nitrogen in the vigorous crop at the foot of the slope that the bug is unable to take. As is well known, the chinch bug never attacks the legumes, and soybeans planted with corn may even help to protect the corn crop from attack by the pest. To prove that high levels of nitrogen in the soil and taken up by the plant will protect corn from chinch bugs, we here at the Missouri Agricultural Experiment Station have reared the pest on seedling corn plants grown on low and high levels of nitrogen and have found that they thrive, breed better and live longer on a diet low in nitrogen. What then is more simple in dealing with this pest than to keep soil fertility high with plenty of nitrogen supplied with legume green-manures supplemented in other ways.

We here, have also found that the small greenhouse thrips likewise seek a diet *low* in nitrogen. The accompanying pictures show luxuriant New Zealand spinach plants grown on high levels of nitrogen and calcium untouched by the thrips while the small, weak plants grown alongside on low levels of these two soil minerals were practically eaten up by the pest. In this case the insect passed up the vigorous type of plants which the market gardener supplies for human consumption while of its own choice it fed only on the undernourished plants in the experiment. Here clearly this insect pest prefers and thrives better on its chosen crop grown on deficient soil at least so far as lime and nitrogen are concerned.

In these experiments, however, we are finding that some insects prefer plants as food when they are grown on soil rich in nitrogen and lime. Take, for instance, common plant lice. They seem to need a rich proteinaceous diet, and are usually found feeding on the tender tip growth where plant physiologists tell us the sap is always richest in nitrogen. They seem to call for less carbohydrates in their diet and actually throw off in their liquid excrement great quantities of sugar as so-called honey dew. Also, the European corn borer seems to thrive best on land which grows the best corn. In cases of those insects which demand more nitrogen and richer diets we have reasons to hope we may be able to reach them by still keeping up the soil fertility where it should be but possibly by varying some of the minor elements, or possibly by stepping up still further potash and other carbohydrate-producing soil elements. We may in this way make our bountiful crops untasty for insects but increasingly nutritious for man and beast.

Attacking the Insect Through His Stomach

In fighting our insects through the soil, in place of using so much spray poisons, we are trying to make the crop either less acceptable to them or less satisfactory to them as a normal diet. The insects' ability to reproduce abundant offspring is known to be closely linked with the chemistry of the food they eat. For instance, the queen honey bee, the only individual female in the hive which ever normally reproduces, is from infancy fed on a highly nutritious, predigested royal jelly diet. All of the worker bees are likewise females, but they are fed on a thinner diet and as a result their ovaries remain undeveloped. However, the diet they receive does step up their brain power, energy and the other factors so essential in the business-like workers who really "run the show" in every beehive. If through the soil we can reach our insect pests with diets that tend to slow down their power of reproduction we will have won the major battle with our insect foes. And do not forget for one minute that they are still giving us a "battle royal" as the one group of animals which most strongly challenge our right to run this globe.

200 Years of Organic Farming

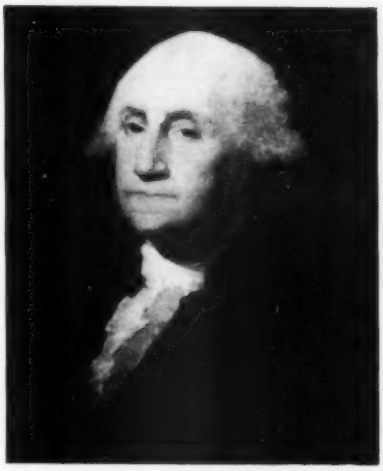
"Much land has been scratched over and none cultivated or improved as it ought to have been," wrote our first president in 1791.

PART I

By ALDEN STAHR

WHEN I first started farming, naturally I thought that organic farming was something new in the United States, but a series of incidents led me to discover that it has been going on, quite consciously, ever since about 1750. In other parts of the world, natural farming has been going on for some four thousand years in China and almost as long in India and Peru, but this was traditional and instinctive, in areas which had never been visited by the Liebig blight and other attempts before Liebig to substitute man-made chemical stimulants for the balanced processes of nature. When I refer to organic farming in the United States I mean a conscious and deliberate effort to farm in accordance with nature's law of return and to resist the temptation to use artificially-made and highly-soluble materials which are in the long run detrimental to the health of soil, plant, animal and mankind.

There are two reasons for selecting 1750 as the starting point of American organic farming. The first use of artificials occurred about that time (burnt lime) and it was shortly after this that George Washington began his experiments in the natural refertilization of soil at Mount Vernon. Of course, the Indians and some early colonists used natural plant foods, but they had no commercial fertilizers to tempt



Ewing Galloway

them, and besides, that's another story. Let's go back to . . .

1748

Just a few miles from Starland Farm, but long before it existed under that name, a traveller by the name of Kalm, observing farming practices around New Brunswick, New Jersey, had this to say about the use of burnt limestone: "The people pretend that this stone is a very good manure, if it is scattered upon the corn fields in its rubbish state, for it is said to stifle the weeds; it is, therefore, made use of on both the fields and in the gardens."

And in this same direction, Pownall said in 1775, "Every farmer has a Limekiln burnt for the dressing of his land, and they raise a great deal of wheat."

Many believe that it was the Germans following Liebig in 1840 who first brought commercial fertilizers into use, but even two hundred years ago, other Germans had already brought a commercial fertilizer, calcium sulphate (gypsum), to the New World and started using it near Philadelphia.

Early Organic Methods

It was also near Philadelphia that the first botanist of the New World, John Bertram, was accomplishing prodigies of production by means of some remarkably modern organic methods around 1750. In *Letters from an American Farmer* St. John Crevecoeur said, after a visit to Bertram's farm: "The whole store of nature's kind luxuriance seemed to have been exhausted on these beautiful meadows; he made me count the amazing number of cattle and horses now feeding on solid bottoms, which but a few years before had been covered with water. Thence we rambled through his fields, where the right-angular fences, the heaps of pitched stones, the flourishing clover, announced the best husbandry, as well as the most assiduous attention. His cows were then returning home, deep-

200 Years of Organic Farming *Continued*

bellied, short-legged, having udders ready to burst; seeking with seeming toil to be delivered from the great exuberance they contained; he next showed me his orchard, formerly planted on a barren sandy soil, but long since converted into one of the richest spots in that vicinage.

" 'This,' said he, 'is altogether the fruit of my own contrivance; I purchased some years ago the privilege of a small spring, about a mile and half from hence, which at a considerable expense I have brought to this reservoir; therein I throw old lime, ashes, horse-dung, etc., and twice a week I let it run, thus impregnated; I regularly spread on this ground in the fall old hay, straw, and whatever damaged fodder I have about my farm. By these simple means I mow, one year with another, fifty-three hundreds of excellent hay per acre, from a soil which scarcely produced five-fingers (a small plant resembling strawberries) some years before.' This is, Sir, a miracle in husbandry; happy the country which is cultivated by a society of men, whose application and taste lead them to prosecute and accomplish useful works.

" 'I am not the only person *who do* these things,' he said. 'Wherever water can be had it is always turned to that important use; wherever a farmer can water his meadows, the greatest crops of the best hay and excellent aftergrass are the sure rewards of his labours. With the banks of my meadow ditches I have greatly enriched my upland fields; those which I intend to rest for a few years, I constantly sow with red clover, which is the greatest meliorator of our lands. For three years after, they yield abundant pasture; when I want to break up my clover fields, I give them a good coat of mud, which hath been exposed to the severities of three or four of our winters. This is the reason why I commonly reap from twenty-eight to thirty-six bushels of wheat an acre; my flax, oats and Indian corn, I raise in the same proportion.' "

Is not the most "modern" agricultural practice to dissolve plant nutrients in irrigation water? But Bertram was too wise to use highly-soluble artificial fertilizers; he used river silt which contained slowly soluble minerals and the trace elements necessary to raise his abundant crops. And do we not now plant clovers to build up the soil for several years of cropping, and activate the decomposition of the cover crop by spreading humus or manure?

But let's move along with history a few years and examine the record of experiments with organic fertilizers by another organic farmer of colonial times, George Washington, in 1760, shortly after he acquired Mount Vernon.

Washington's Experiments

Washington subdivided a box into ten compartments and supplied each with organic fertilizer as follows:

1. — "three pecks of earth brought from below the hill out of the 46-acre field without any mixture.
2. — two pecks of sand earth and one of marle taken out of the said field, which marle seems a little inclined to sand.
3. — two pecks of said earth and one of river sand.
4. — a peck of horse dung.
5. — mud taken out of the creek.
6. — cow dung.
7. — marle from the Gulleys on the hillside, wch. seem'd to be purer than the other.
8. — sheep dung.
9. — black mould from the Gulleys on the hillside, wch. seem'd to be purer than the other.
10. — clay got just below the garden."

All of these except number one were mixed with an equal quantity of earth and granulated by rubbing together on a cloth. In each section Washington planted one grain of wheat, three of oats and three of barley, all equidistant in rows and set at equal depth by a machine he designed for the purpose. The element of personal care is evident in Washington's words, "Two or three hours after sowing in this manner and about an hour before sunset I watered them all equally alike with water that had been standing in a tub about two hours exposed to the sun."

After allowing the seeds to grow for three weeks, Washington looked over the boxes and decided that compartments 8 and 9 (sheep dung and black mould, respectively) yielded the best.

He Was Scornful of Contemporary Methods

Washington was scornful of the agricultural methods of his day and had this to say about them: "A piece of land is cut down and left under constant cultivation, first in tobacco and then in Indian corn (two very exhausting crops) until it will yield scarcely anything; a second piece is cleared and treated in the same manner; then a third and so on, until probably there is little more to clear. When this happens, the owner finds himself reduced to the choice of one of three things—either to recover the land which he has ruined, to accomplish which he has perhaps neither the time nor the skill, the industry or the means; or to retire beyond the mountains; or to substitute quantity for quality in order to raise something. The latter has been generally adopted and with the assistance of horses, he scratches over much ground and seeds it, to very little purpose." And as an example of the results obtained by such husbandry, or lack of it, Washington estimated a wheat yield in 1791 of about ten bushels per acre. This is in sharp contrast to the results obtained by organic

farmer Bertram, with his 28 to 36 bushels of wheat per acre.

In that same year (1791), Washington wrote to a friend by the name of Arthur Young: "The aim of farmers in this country (if they can be called farmers) is, not to make the most they can from the land, which is or has been cheap, but the most of labour, which is dear; the consequence of which has been, much ground has been scratched over and none cultivated or improved as it ought to have been; whereas a farmer in England, where land is dear and labour cheap finds it to his interest to improve and cultivate highly that he may reap large crops from a small quantity of ground."

Nine years earlier, Washington decried the practice of exhausting land and then simply letting it go to weeds instead of restoring the land with cover crops. It was in 1782 that this "Friend Sykes" of Revolutionary times said, "My countrymen are too much used to corn blades and corn shucks and have too little knowledge of the profit of grass land."

Along this same line, he had further to say in 1787: "The general custom has been, first to raise a crop of Indian corn (maize) which according to the mode of cultivation is a good preparation for wheat; then a crop of wheat; after which the ground is respited (except for weeds and every trash which can contribute to its foulness) for about 18 months; and so on alternately, without any dressing, until the land is exhausted; when it is turned out, without being sown with grass seeds or reeds, or any method taken to restore it; and another piece is grown in the same manner. No more cattle is raised than can be supported by lowland meadows, swamps, etc. and the tops and blades of Indian corn, as very few persons have attended to growing grass and connecting cattle with their crops. The Indian corn is the chief support of the labourers and their horses."

Interested in Silt

Washington as well as Bertram was consumed with interest in the silt of river bottoms. Referring to Mount Vernon, Washington said in 1793, "Its margin is washed by more than 10 miles of tide water; from beds of which and the innumerable coves, inlets and small marshes with which it abounds, an inexhaustible fund of mud may be drawn as a manure, either to be used separately or in a compost . . . The soil of the tract of which I am speaking is a good loam, more inclined, however, to clay than sand. From use, and, I might add, abuse, it is become more and more consolidated, and of course heavier to work."

During the Revolution, Washington scarcely saw his beloved acres at all, but after his soldier's job was done he returned to the work he liked best—farming in such a way as to conserve and improve the soil even while making crops—and decided that a combination of grasses

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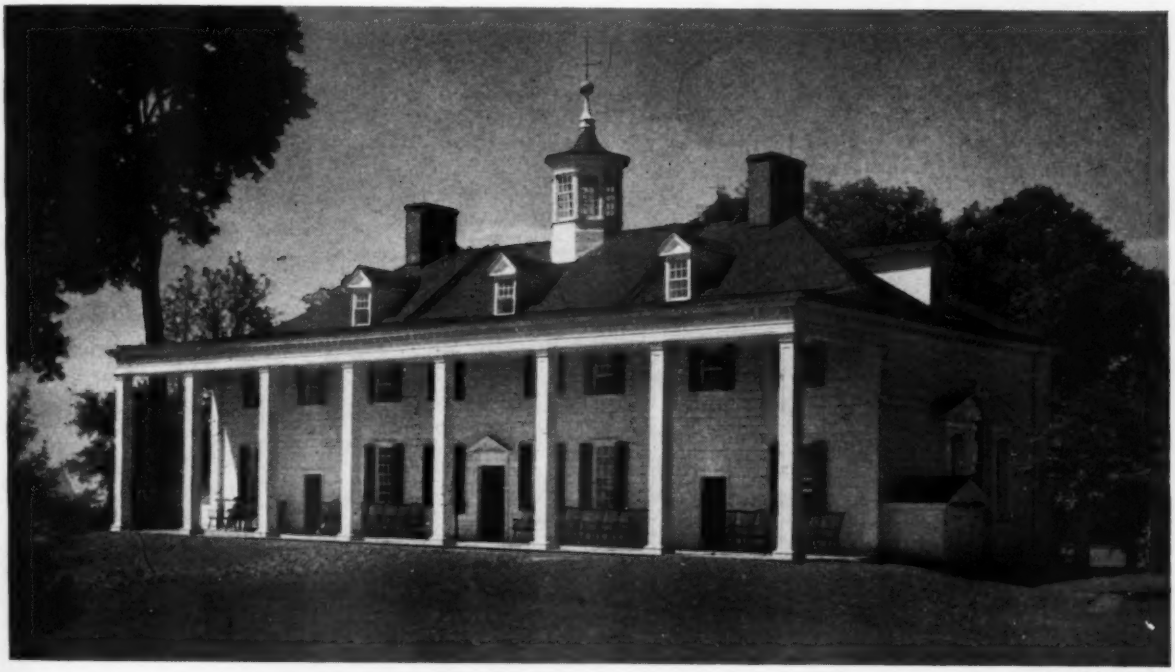


Ewing Galloway

Mount Vernon, the scene of Washington's agricultural experiments.

JOHN DEERE

An authority takes a stand on that controversial question . . . .

Why Do Farmers Plow?

Part I

By WM. A. ALBRECHT

Department of Soils
University of Missouri

From Better Crops with Plant Food

THAT is "an easy question to answer" for the farmers who know how to plow and who "like to plow." They are legion who "get pleasure out of seeing the soil turn turtle," and who will tell you that they plow to improve their crops in quantity and in quality. To fly into the face of the testimony which is the observation of the myriads of tillers of the soil during the ages past, and to deny that there is any scientific basis for this practice, even if it is not known by the farmers, will demand strong and sound evidence.

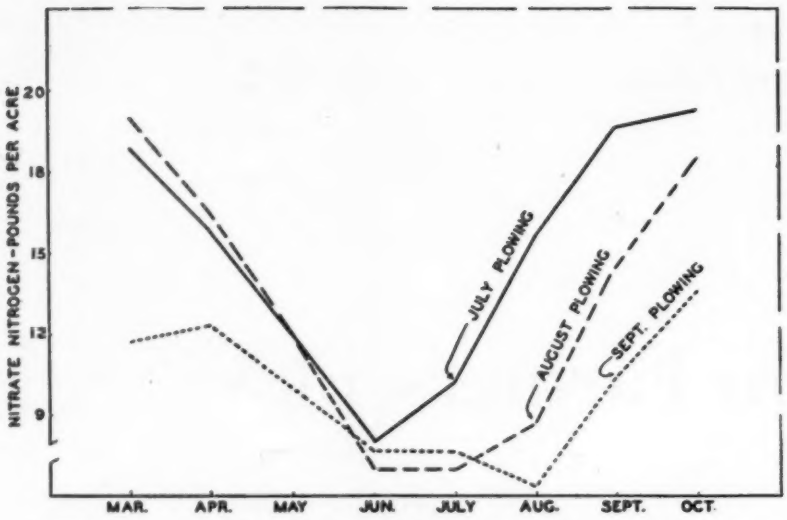
Without doubt, we have been doing too much plowing, but there is a background of birthright and history for it. North European origin and ancestry, so common in the United States, brings plowing into the foreground as a tillage habit to aerate and warm the heavily textured soils of that climatic region. Farming demanded plowing, and one doesn't make a living without plowing on a farm that is of clay loam or clay texture, and under liberal and regular rainfall. Areas of older agriculture have survived because of heavy soils. Agriculture on sandy soils has been fleeting. Farmers from these older agricultural sections couldn't conceive of farming without plowing. To them, as to the majority of us, the plow has always been the symbol of agriculture.

Plowing without understanding its functions in relation to the soil and the soil fertility, however, now demonstrates that we have done too much plowing—and much unnecessary plowing. There is the inclination in this confession to condemn the very practice itself. Because too much alcohol, strychnine, or opium taken indiscriminately is deadly, shall these stimulants and pain relievers be denied to the physician? We have been too prone to treat all soils, regardless of texture and structure, to the same frequency of plowing. We are just now examining this, at least from the viewpoint of economy.

Incorrect use of the plow has given it a bad name that it doesn't deserve. This farmer, plowing up and down a hill, is exposing his land to erosion.

Results of Excessive Plowing

During the importation of the plowing idea and the application of the practice in the United States, our ancestry did not recognize their transition to soils that are mainly silt loams, that demand less plowing than European clay loams. They failed to appreciate the connection plowing might have with their movement from regions where the rainfall comes regularly in small showers



Nitrate nitrogen levels in the soil under wheat reflect amounts and time of rise related to time of plowing.

Why Do Farmers Plow?

Continued

to those where a large share of the rains are torrential. This failure was more serious in our westward trek to central United States, where the relative torrential nature increases as total rainfall diminishes. This shift from maritime to continental climate was not appreciated until much plowing under torrential downpours put erosion of almost catastrophic magnitude over our most productive areas.

Our ancestors—and we, like them—failed to recognize also that in moving some 700 or more miles southward, one is going toward increasing continentality with its higher and more fluctuating temperatures. Here is the biological aspect of the rapid rate with which the reserve organic matter in the soil has been burned out. This was the basis of the high crop yields enjoyed by the pioneer for his much plowing. These yields were purchased at tremendous soil fertility costs, and this almost explosive exhaustion of the soil organic matter in our brief history has left the soil less receptive to the heavier rainfall, has encouraged greater run-off, and has brought with it the damaging erosion. Excessive tillage by plow and otherwise has not yet brought us to appreciate that it has also exhausted from the cultivated soils the very plant nutrients that now prohibit nature from quickly growing the vegetation that would cover her nakedness and reduce the erosion hazard.

Yes, we have plowed too much, as our hindsight forcefully tells us. But surely our foresight is better than to allow refusal to plow in the future.

Plowing Puts "Life" Into Soil Factory

Plowing does aerate the soil, as any soil microbiologist will testify. As a consequence of the change of atmosphere in the soil and because of the stirring by the mold-board plow, there is new "life." The soil is a factory in which much energy is expended. It is transforming many substances, oxidizing or burning tons of carbon to carbon dioxide, sulfur to sulfur dioxide, ammonia to nitrate, and other similar combustions. These important facts are disregarded as part of the soil's contribution to production of crops by him who would not plow.

When a 40-acre corn field under maximum growing activity in July is burning to form carbon dioxide the carbon equivalent of that used in running a steam engine of 40 horsepower, can anyone deny the necessity of air for such a performance? Surely no one will close the draft and destroy such producing power by refusing to plow.

Air in the soil is not wholly a matter of the shifting water table, as soil science of the vintage of 1910 suggests. Water tables are located at extreme depths. This has been revealed by the numerous studies encouraging soil conservation because it is a practice in water conservation. These depth figures are so large as to be ample evidence that fluctuations of the water tables, even over wide range so far down in the soil profile, could mean nothing in the way of atmospheric air exchange with that in the surface soil.

Then, too, water can move up and down in the soil without moving as a whole water table. It can move without necessarily exchanging air within the soil for that in the atmosphere above it, much as water in the lower half of a bottle can exchange place with the air above it as the bottle is inverted, but yet remains tightly stoppered. Just as atmospheric air plays no role in this exchange of places by water and air in the bottle, just so can water move in the soil and air can move in the opposite direction, without atmospheric air entering.

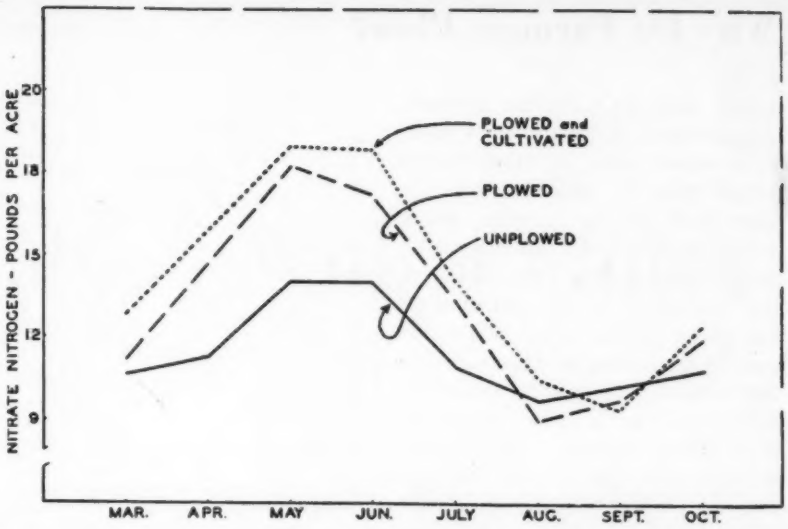
Then, too, oxidations can occur in the soil in the absence of atmosphere. Chemical compounds of oxygen in the soil give up this element to supply it for various functions. It serves to burn substances in the soil just as saltpeter mixed with charcoal burns the mixture with a speed explosive enough to be gunpowder. Atmospheric burning of charcoal is too slow to make it serve as explosive.

The burning business in the soil by means of oxygen from the air or from chemical combustions serving in microbial respiration must go on

if the plant nutrients tied up in combination with carbon are to be released for repeated use by other plants of succeeding generations. Were this performance not proceeding in the soil, life on the globe would soon become extinct. The soil's producing power would soon be expended. All of its chemical nutrients for sustenance of life, or its soil fertility, would be in combination in its own products of growth above the soil. As a result, the soil could offer nothing and no growth could occur. These fires of oxidation, because of microbial life and activities within the soil, undo these growth products and let the elements make the cycle of growth, death, and decay again. The plow is a means of giving extra draft to hasten this cycle. Shall we prohibit this cycle by refusing to plow?

That plowing improves the efficiency of the soil, not only for oxidation of carbon but also as a nitrogen oxidizing factory to deliver this latter element in the form of available nitrates, is known to those familiar with the more recent developments in soil science. The soil's supply of soluble nitrogen increases during the early growing season as the temperature rises. It may rise to a very high point in fallow soil, or may be consumed by vegetation. It may be leached out by rainfall. It is low again by fall. It declines with the falling temperature or may be held down by excessive drying.

Some studies of the nitrate supply in the soil under corn during the growing season in three adjoining plots, one unplowed, one plowed, and one plowed and cultivated, tell forcefully that plowing provides a larger supply of soluble nitrogen as nitrates. These were the results also in the absence of the crop and of weeds. Cultivating the soil three times, as corn is commonly handled, provides extra nitrate nitrogen via the soil as the producer of this plant nutrient. Crop yields follow in order of the level of these nitrate supplies. The crop depends on the rate of delivery of the soil fertility.



Nitrate nitrogen under corn during the growing season as influenced by plowing and cultivation.

The farmer may not know that these higher levels of nitrate are the more direct cause of his improved crop yield associated with his making the "soil turn turtle." He plows ahead of the corn planting in order to get a better corn crop. His inability to point out the underlying scientific channels through which the effects of plowing are transmitted to the crop does not put the plow into bad repute in his sight. Surely, the hundreds of corn producers will not suddenly discard so ancient an implement merely because they cannot call to their help this scientific evidence when someone concludes for them that the plow is the cause of increased erosion and other devastation that is so easily associated with it.

Plowing and cropping a soil year after year bring with them declining crop yields. For these one might readily pounce upon the plow as the culprit in the case. But one must not forget that cropping includes one crop above the soil as complex vegetation and another one within the soil as simpler biochemical products in microbial operations. Soil plowed out of sod and put to crops such as corn or wheat, continuously, soon runs to bare land. Shall we blame the plow as it turns under trash and crop residues to make the field look clean? To the uninformed, this would seem to be evidence that "backfires into the argument that plowing produces a better environment for plant roots." The declining crop yields, which we have been trying so desperately to bolster up by imported crop substitutes or by new creations of the plant breeder, have other causes than merely the plowing operation. They cannot be explained away by the simple belief that "the explosive separation of the soil mass wrecks all capillary connections temporarily"; and that "the organic matter sandwiched in further extends the period of sterility of the soil due to dryness." Such deductions are much outmoded when they still pin all explanation on the movements of soil water.

Sterility of the soil is not always a matter of desiccation. Much as liquor has come and gone in our many discussions and legislations to eventually find its limited place in human life and let us move on toward a better understanding of nutrition as basic to our national well-being, so the water factor in plant existence has now been accepted as one under nature's control in quantity. Our attention has gone to plant nutrition as the managerial factor,

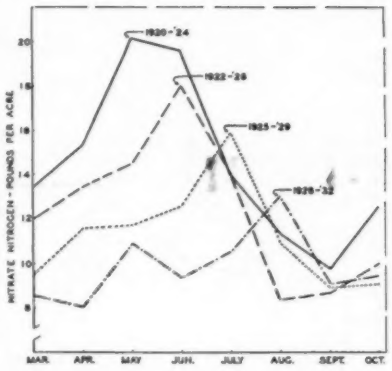
Why Do Farmers Plow?

Continued

where with little fertility addition we can do much for the plant, even to its water needs. As Mark Twain would have it, water in the soil goes back to the weather about which there is much talk but about which little is done. The factor of soil fertility, or of the nutrition of the plant, is one about which we can do something to give us more and better crops for the weather we have. Crops are as they eat, not as they drink. Fighting the weather is less helpful than fixing the fertility of the soil. Crops are not declining or failing because plowing is drying out the soil.

The forces that push plowed land into bare are not the moldboard plow and the horses or tractor with it; they are the continued removal of soil fertility with little return. They are the gradual exhaustion of the stores of fertility in a soil that must first feed the crop of bacteria within before these life forms can leave something for the crop above. Continued and excessive cropping along with the product removal, reduce the output of the nutrients left over in soluble form by microbial activity. The microbes merely rework what is given them.

The nitrates, or the available forms of nitrogen, are brought down to a very low level in the soil in June by the wheat crop just before its harvest. Early plowing in July for the next crop starts their accumulation in the soil again and the curve begins to rise. In the stubble soil the nitrates stay low. But when this stubble is plowed in August, this soil-stirring operation starts the nitrate supply upward. Delay in plowing until September lets the growing weeds reduce the nitrate supply in the soil even below that possible in exhaustion by the wheat crop. Here is a reason based on nutritional evidence that explains why late plowing for wheat makes it a poor crop, even when weeds are turned under as a green manure crop. For



Nitrate nitrogen levels in soil during succeeding five-year averages for the growing season showing declining supplies with maxima coming successively later in the season.

wheat, plowing in July makes a better crop, but the same operation in September makes a poorer one. Can we then blame the plow when the same performance in turning the soil is both good and bad for the crop, all within the short time of three months?

The microbial crop comes in for the explanation. The microbes must be fed first. They eat at the first table, the wheat at the second. Early plowing puts under little organic matter. It compels the bacteria to oxidize the humus of the soil that has already been worked over to the point where it has a narrow nutritive ratio, or a small amount of carbon as compared with its nitrogen. When bacteria get their energy, they burn much of the carbon and leave the soluble nitrogen to accumulate in the form of nitrates as nourishment for the wheat, to its better growth.

Late plowing that turns under weeds represents a case of feeding the bacteria with a diet of excessive carbon and of deficient nitrogen. The weeds that grew in the stubble after the wheat had taken most of the nitrogen couldn't be nitrogen-rich. They were carbon-rich or woody. Turned under, this excessive supply of carbon as energy material compels the microbes to use the soil nitrogen to balance their nutritional needs. They put this soluble nitrogen into complex, insoluble combinations resulting from weed decay. The wheat crop following finds little nitrate in the soil. It starves when in competition for such with the microbial life in the soil.

Under such circumstances, plowing may be given the blame by those who have never understood the bacteria in the soil. But certainly it isn't the plow. It is the deficient supply of soil fertility that is too low to make weeds that can contain much in the way of nutrients from the soil and must, therefore, be made from air and water coming from above the soil. Nutrients from that source can serve to make only woodiness. The fertility is also too low to balance a woody or carbonaceous green manure as the main part of the microbial diet, and to leave anything in addition as nourishment for the wheat crop.

There are other scientific bases for plowing besides the aeration of the soil for the combustion or decomposition encouraged thereby as means of liberating plant nutrients within the soil. Many other phases of microbial life contribute to support the plow as an important agricultural implement. At various agricultural experiment stations, other scientists than microbiologists have given thought to the effects of incorporating organic matter into the soil by the plow and other methods. Basic soil information in connection with the "debacle in which our American soils have drifted" has been established by other men of science who man our various stations. They include those concerned with soil fertility, plant nutrition, soil mineralogy, colloid chemistry, animal physiology, soil, and other aspects of science not even considered as closely connected with soils at so recent a date as 1910. All these can support the farmer in his art of plowing and can give a scientific answer, even if he can't, to the question "Why plow?"

(To Be Concluded)

Loosen Subsoil With a Mulch

By JOHN MOYER

I HAVE learned by experience that mulch farming comes about as close to the ideal tillage practice as is possible. In the six years that we have followed the mulching program the hardpan is something that has been relegated to the past. This was rather forcibly brought to focus for me when I was persuaded to purchase a Windy Subsoiler for my Ford-Ferguson tractor in order to conserve moisture and break up the hardpan that was thought to still exist. After using the subsoiler a while I began to realize that little if any hardpan existed even on higher ground, where the moldboard plow had difficulty in penetrating seven years before. No difficulty in pulling was encountered.

Usually when we hear of subsoiling operations we expect much heavier tractors to be employed because of hard conditions. Moisture is always present when the mulch covers the surface, and when moisture is available even in dry weather, the organic matter, bacteria, earthworms and other soil life can properly live out their life cycle, with the result that in such a soil one will have no difficulty in raising an excellent crop.

I use a three year rotation for mulch farming: A row crop followed by grain, then sweet clover or soybeans as a cover crop. This results in plenty of vegetable matter to work into the surface as a mulch. Therefore, when it rains there is lots of spongy material in the right place to soak up the water and it will remain where it falls. This is the real solution to the erosion problem. What is more, it can be done more economically than the present modern farming operations and it is also considerably more economical than heap composting on a large scale. In such soil, hardpan conditions of former years cease to exist.

Mulch farming has proven to be a more economical way of operating my farm and to my way of thinking is a most practical way of applying the organic method.

Above and Above Right: John Moyer's mulch.

Experiments have shown that hybrid corn is of less value for feed than the open pollinated varieties.

One Opinion of Hybrids

Here is a man who prefers old-fashioned corn.

By ERNEST M. HALBLEIB

From Bio Dynamics

SINCE the days of Liebig's discovery more than 100 years ago, there have been many attempts to get larger yields from almost all crops, including corn. The development of the hybrid varieties is the latest attempt to increase yields of corn. All attempts have been accompanied by a loss in quality. And in every instance, increases in yields have been at the expense of the soil. The "increase in fertility of the soil," as shown by yields, has in recent years been in too many cases measured by the yield of hybrids.

At Halbleib Orchards farm, we have tried both—the open or natural pollinated varieties, and many hybrid varieties. At present, we are using only Krug Open Pollinated, because of its better quality, it having never been de-tasseled. The selection of this seed has been along the lines of type of ear and ripeness, with only those ears taken which are in seed condition at harvest time without artificial drying of any green ears.

A warning by the Chicago Museum of Natural History has revealed that hybrid growers were on dangerous ground as to their foundation breeding stock, and that old stable varieties, to which hybrids owe their existence as well as their continuation, were going toward extinction. The history of most hybrids would probably reveal that the different crosses were too far already from the original to which they owe their beginning.

Here at our farm, in 1948, careful tests showed the open pollinated to contain more protein, more minerals and less moisture and a correspondingly better seed condition. Spectrographic tests of several hybrids showed that none of those tested contained cobalt, while some soils under them had cobalt. These same tests showed the hybrid varieties to contain only 13 to 16 minerals out of some 30, while the open Pollinated Krug had 22, including cobalt.

Our tests in 1949, where hybrids were grown on 11 different farms, in the same field with open pollinated, showed again—in 8 cases out of 11—that the open pollinated had more protein. The mineral test varied more according to the soil. The open pollinated did better on soils which had no fertilizer of any kind applied and did equally as well in all plots. The yield was equal to the hybrids or greater. The highest open pollinated yield was 80 bushels per acre,

while the hybrids' best was around 70. Standing quality of the Krug was even better than the hybrids in most cases, and it was characterized by larger and better-filled ears that were also in better seed condition. In 1948 it was 6½% drier than the hybrids. Corn borer infestation was even greater among the hybrids than with open pollinated.

A test for standing was provided by a 55-mile wind which put many fields in a straw-broken condition, without the aid of the corn borer. Many fields were a tangled mess and machines left as high as 30 bushels per acre in the fields in 1949. The 1948 picture showed as bad as 20 bushels per acre left in seed fields. This was picked up by hand and dried, but lowered germination to 80 when mixed with the standing seed. The 1949 results are not all in yet, but steel storage bins of 1948 corn reveal sprouted corn and much moisture. It is a well-known fact that hybrid corn is bringing so much moisture to market that huge drying plants are now used to reduce moisture content—and still 1948 corn turned black in storage.

Hybrid stalks were a foot shorter than the open pollinated, and hybrid ears were smaller and were poorly filled at both tips and butts. Position of ears of many hybrids is now very un-uniform. Years of observation and two years of testing side by side have led us to the following conclusions:

1. The selection of seed by taking all the ears—both green and ripe—which can be artificially dried and all used for seed, has led to a demand for a longer season in which a green crop can mature. Hybrid crops of the past few years are bringing so much moisture to the market that huge drying plants are now in existence. Storage of corn is largely going out of the hands of the farmers as a result.

2. The selection of the riper ears only, for seed, will produce crops of corn at harvest time with less moisture and of better seed and feed condition, also facilitating storage.

3. The selection of the medium flat kernels of the middle section of the ear and the excluding of the other portions of the ear for seed will lead, or has already led, to crops of ears not well filled at either end. In contrast, the saving for seed of well filled ears and planting seed from the *entire* ear (excluding only bad or ill-formed kernels) will continue to insure a better filled ear at harvest time.

4. Since tests have proved that the tassels contain more vitamins than the ears, it is evident that they should not be discarded.

5. Bull rows (the rows which are left to do all the pollinating in a hybrid seed field) have been found to have more perfect ears and better-standing stalks than the de-tasseled portion of the field which is producing the Hybrid corn seed.

6. Our conclusion here is that the continued de-tasseling of seed corn will, and has to an extent already degenerated our varieties to a point of less feed value. It evidently cripples a variety for picking up a *balanced* ration out of any soil, to detassel the stalk which produces the seed. The Nebraska Station reports in Bulletin No. 144 that feeding open pollinated corn (in comparison to hybrid) made chicks gain faster and have more protein in the meat in the end. It is interesting also to note that hybrid sweet corn in most varieties is no longer sweet. Also that open pollinated corn put into silos made silage of far superior quality as compared to hybrids.

7. Since we find that when the reproductive element is left out of food—as in the case of germs of grain—such grain is lacking in essential food values, we then conclude that the de-tasseling of corn which alters the reproductive power of the seed also alters the quality of that corn for feed.

8. We further conclude that when only about 1/5 of the hybrid seed field is used to pollinate the other 4/5 of the field or all of that field which goes for seed, we are running further into production of an inferior corn crop.

9. Throughout all nature, reproduction is the proof of life and is the end result that is provided for in a plant or animal. Without reproduction, that plant or that animal becomes extinct. Reproductive power in animals is closely related to the reproductive power of the plants which these animals eat. So when we use a variety which will not reproduce itself, such as hybrid corn, we are undermining the health of the animal which consumes that plant to support itself in life or strength. If this law holds good in regard to the domestic animals it will surely hold good also for the human race.

10. The profit motive has brought hybrid corn into existence. Hybrid is known to be more demanding on trace elements of soils and is therefore more of a fertility-consuming crop than the natural open-pollinated. The Middle West is in an uproar over the corn borer. The exhaustive demands of hybrid corn have led to more infestation by this pest and by various diseases.

11. Hybrid corn is a very poor answer to the cry for greater yields. It has brought on more poison spray, which has not proved a *cure* in any case. So the vicious cycle is accelerated.

12. We have been thoroughly convinced, beyond a reasonable doubt, that corn can be improved only by field selection and by the *organic methods* applied to the soil on which it is grown.

13. We are fully convinced that de-tasseling is not in Nature's plan for improvement, and the fact that hybrids do not reproduce themselves proves to us that we are only putting off the day of reckoning and are providing only an inferior product. And we further believe that if there is a surplus of quantity at this time, there is not now, and never will be, a surplus of quality of corn. And the answer to the yield problem is new soil from the *cycle of life* and not new varieties.

A Seminar on

NITROGEN

A soil's nitrogen, like the rest of agriculture, depends on organic matter.

By WM. ACKERMAN

THE nitrogen of soils is found largely in organic matter. As this organic matter decomposes, the nitrogen becomes available and is either used by plants or leached from the soil. In arid sections, soluble nitrogenous salts may accumulate in the soil because there is insufficient rain to wash them out, or to permit any great amount of plant growth. If, through careless systems of management, the organic matter content of a soil is permitted to become depleted seriously, the injurious effect on most crops is due primarily to an inadequate supply of available nitrogen. In fact, there is such a close relationship between the supply of active organic matter and the nitrogen content of farmed soils that a marked deficiency of one constituent indicates a lack of the other.

Surface soils generally contain from 1000 to 5000 pounds of nitrogen to the acre in the top seven inches. Some sandy soils, particularly in the South where climatic conditions have been especially favorable for the decomposition of organic matter, may contain less. The brown and black prairie soils may have as much as 10,000 and some peat has 40,000 pounds of nitrogen an acre.

Humus accumulation is dependent on the supply of nitrogen, since the ratio of nitrogen to carbon seldom exceeds 1 to 20. Therefore, the return to the soil of organic matter with a high nitrogen content is necessary for the rapid accumulation of humus. Consequently, farm manure and legume green manure crops are more efficient sources of organic matter and nitrogen than the straw and non-legume green manures.

Since the effectiveness of organic matter in supplying nutrients is dependent to a large extent on the rate of decomposition, it is important to appreciate the factors which influence this important process. A supply of nitrogen adequate to satisfy the needs of the decomposing bacteria is essential. For this reason, the addition of plant residues and organic fertilizers high in nitrogen content to material low in nitrogen content will hasten the decomposition process.

Soil conditions should be made favorable for the activity of the nitrifying bacteria of the soil. Adequate soil aeration is important as a favorable soil reaction. Consequently, adequate drainage and tillage should be provided, and sufficient lime applied to counteract soil acidity to the point favorable to the functioning of the decomposing organisms.

Why is it safer to feed plants nitrogen by the organic method than through the use of chemical fertilizers?

Organic forms of nitrogen are more stable in the soil and become available for plant growth more gradually than nitrogen from chemical fertilizers. When concentrated chemical nitrogen is applied to the soil it produces a "shot-in-the-arm" effect to plant growth. The plants are subjected to too much nitrogen at one time. Then, if a sudden heavy rainstorm drenches the field, the chemical form of nitrogen is, to a large extent, washed out, and the plants become starved for the lack of this element.

Many highly concentrated nitrogen fertilizers are toxic in their effect on earthworms. Nitrogen-fixing bacteria which normally take nitrogen from the air and make it available in the soil, will discontinue to carry on this process if concentrated nitrogen is added. These organisms will then use the applied nitrogen rather than make their own from the air.

How can we grow good crops without using concentrated nitrogen fertilizers?

Nitrogen fertilizers are among the most expensive fertilizing materials that the farmer buys today.

It is quite logical and true that highly concentrated nitrogen fertilizers are not necessary. The air we breathe is 79% nitrogen, and yet many farmers experience nitrogen deficiency in the soil. Why is this? It is because the nitrogen is not made available in the soil for plant growth. When large quantities of organic matter are incorporated in the soil there is a tremendous increase in soil microorganisms, activity including the nitrogen fixing bacteria. These bacteria take nitrogen from the air and make it available to the plants in the form of nitrates and ammonium products. Under organic methods of culture, these organisms supply sufficient nitrogen to the soil so that nitrogen fertilizers are not needed. This can be a very large saving to the farmer's fertilizer bill.

How important are nitrogen materials in composting?

Materials high in nitrogen content are extremely important in composting. The principles underlying composting are the laws of bacterial action. Bacterial activity (and all other living processes), is dependent on two essentials: energy food in the form of carbohydrates, and growth food in the form of proteins. The best mixture to supply this needed food is three parts (by volume) of plant residues and one part (by volume) of animal matter.

One cause of improper composting is insufficient nitrogen. An oversupply of nitrogenous matter is less harmful than an undersupply, because a natural balance is soon achieved in nature. It is important that the individual use materials relatively high in nitrogen in composting, for if the bacteria cannot obtain it from these materials, they will severely reduce the nitrogen in the soil to further the breakdown of the plant substances. As a result, the growing crops will have to get along on a low nitrogen ratio.

Does the enclosed manure pit save more nitrogen than other methods of composting manure?

Yes, the enclosed pit method of composting prevents much of the loss of nitrogen from manures that takes place in open pit systems. It is generally known that a watertight floor, equipped with a surrounding low wall, a drainage channel, and a small concrete cistern can considerably reduce loss of phosphorus, potassium, and those parts of nitrogen and organic substances that would otherwise be dissipated by washing out and by infiltration. But there are other losses of nitrogen from oxidation and combustion of organic materials that have been found to be of far greater importance.

A few decades ago, the famous chemist, Deherain, carried out experiments which showed the relationship of loss of nitrogen when manures were composted with varying amounts of air. The results are as follows: imperfectly anaerobic (very little contact with air) a loss of 19.2 per cent of the original nitrogen; aerobic (in contact with air), 38.2 per cent loss of original nitrogen. When no air at all was allowed to come in contact with the decomposing organic matter, there was no loss of nitrogen.

What happens to a plant that does not receive nitrogen?

Nitrogen is particularly needed by plants for vegetative growth. In the absence of nitrogen, a plant makes no appreciable growth. With only a limited supply, growth is begun in a normal way, but as soon as the available nitrogen is used up, the lower and smaller leaves begin gradually to die down from the tips, and all of the plant's energy is centered in one or two leaves. The plant makes a limited root development and the leaves turn yellowish, showing lack of nitrogen for chlorophyll formation. When there is an abundance of nitrogen, vegetation is of a characteristic dark-green color. Excessive amounts of nitrogen lengthen the growing season of a crop, retarding noticeably the date of maturity. This may be very undesirable with certain crops in a short season. Excess nitrogen also weakens the stalks.

Is there any way I can test my soil for nitrogen deficiency by raising certain plants?

Yes, a rather simple test may be performed as follows: select two crops, one such as wheat which is quite sensitive to nitrogen deficiency in the soil, and another like corn which has less difficulty in obtaining this element. Plant two sections of each crop. Apply dried blood or tankage at the rate of four pounds per 1000 square feet on one corn and one wheat section, the other section of corn and wheat being untreated. If both the corn and wheat are benefited by the nitrogen, the soil is in need of this element. If, however, the wheat responds and the corn does not, the soil is not in great need of nitrogen, but does not contain an abundance in available forms.

Is nitrogen distributed evenly throughout the soil, or is it located only at the surface?

The nitrogen in the soil is confined largely to the surface soil. Only in acid regions is there any great amount of nitrogen in subsoils. This means that the crop-producing capacity of a soil will be exhausted as the organic matter in the surface layer completely decomposes into humus and its supply of nitrogen is largely liberated.

In what form is nitrogen present in the soil?

Nitrogen is present in the soil in various forms. As a mineral constituent it is combined with oxygen and such base-forming elements as potassium, sodium, and calcium, forming nitrates and nitrites. Nitrogen, however is primarily in organic combination, being associated

Nitrogen

Continued

with carbon, hydrogen, and oxygen as one of the elements forming the organic matter of soils. Nitrogen may also be present in small amounts in the form of ammonia, or ammonium salts, derived from rain water and from the decay of animal and vegetable matter.

What is the relationship of cultivation and nitrogen content of the soil?

It has been shown that cultivated soils lose humus, and with this loss of humus goes a loss of nitrogen. Snyder, experimenting at the Minnesota Experiment Station, found that through cultivating and cropping, soils lost, over a period of twenty years, as much as 3000 to 5000 lbs. of nitrogen per acre, only 900 of which was removed by the crops grown. About 2500. lbs. of nitrogen per acre in twenty years, was, therefore, a net loss.

Does the nitrogen content of the soil vary appreciably through the use of different crops?

At the Rothamsted station, where exact records are available for many years, the following differences in the nitrogen content of the soil were noted:

Crops and Soil Treatment	Per Cent of Nitrogen in the First 9″
Old pasture	0.250
Arable land in ordinary culture	0.140
Wheat unmanured, 38 years	0.105
Wheat and fallow, unmanured 31 years	0.096
Barley, unmanured 30 years	0.093
Turnips, unmanured 25 years	0.085

When a cover crop is turned under, how soon does nitrate accumulation begin?

The microorganisms attack succulent tissues most rapidly, and the formation of nitrates for crop use follows in a few days or weeks. In the case of very succulent material, the greater part of the nitrate may be produced in the first eight weeks. Studies have been made by many investigators. D. V. Bal found that 56.26 per cent of the nitrogen in young green material was nitrified in two weeks. N. V. Joshi found that nitrate accumulation from young Sesbania began almost at once, was considerable in one week, and nearly doubled in two weeks. F. C. Merkle found a considerable nitrate accumulation in 44 days. R. E. Stephenson found vigorous nitrification two weeks after alfalfa was turned under, and similar results were obtained by A. L. Whiting and R. E. Richmond for sweet clover.

How important are legumes in increasing the nitrogen content of the land?

Legumes take nitrogen from the air by means of bacteria. These bacteria penetrate the root hairs and multiply in the roots. As they multiply, enlargements form on the roots which are called nodules. Their energy and most of their food are supplied by the plant sap. They utilize nitrogen of the air which circulates through the soil, and for this reason are called nitrogen-gathering or nitrogen-fixing bacteria. When nodules form in large numbers on the roots of legumes in nitrogen-deficient soils, even more nitrogen is normally taken from the air than from the soil.

Maximum benefit is secured from legumes if they are either returned to the soil as green manure, or fed to livestock and returned to the land in the form of manure. Either method of disposition returns to the soil a considerable amount of both nitrogen and the organic matter of the tops.

Legumes may benefit the soil in other ways than by increasing the available nitrogen. They are deep-rooted crops, and when grown on heavy soils, they may materially benefit the drainage, as the roots decay and leave openings through the subsoil. They draw heavily on the subsoil, for mineral elements, and consequently a transfer of mineral plant-food from subsoil to surface soil is brought about.

Still another benefit of legumes is not generally appreciated. It is their value in replenishing the organic matter supply of the soil. By furnishing available nitrogen to the crop following, increased growth is secured, which means more organic matter.

Is the inoculation of legumes with nitrogen bacteria a waste of money?

Inoculating legume seed with nitrogen bacteria is not a waste of money. These crops will make but very poor growth if the bacteria are not present. However, it is not necessary to buy the inoculant if the same legume crop has grown in that particular field in previous years. Legume seed may also be inoculated satisfactorily by mixing with the seed soil from some other field that is growing the same crop.

What part of the legume plant contains the most nitrogen—the roots, or the tops?

Experiments have been performed on several types of legumes in which the per cent of nitrogen in the tops and roots and the per cent of entire crop in roots were calculated. The results showed that the tops were richer in nitrogen.

Are the legume bacteria the only beneficial nitrogen-fixing bacteria?

In addition to the nitrogen-gathering bacteria of the legumes, another group of soil bacteria is capable of utilizing atmospheric nitrogen. They are known as independent bacteria and are particularly active in soils that are well supplied with organic matter. Azotobacter and Clostridium are two of the most important of the independent bacteria. Under favorable conditions, independent bac-

(*Continued on page* 59)

Plant Windbreaks To Increase Farm Income

Reduce wind erosion and protect your crops with a wall of trees.

By JOHN SCOTT DOUGLAS

DURING a severe forty-seven-mile-an-hour blow, a Fontana, California, citrus orchard suffered neither fruit nor tree damage. As a rule, fifteen- to twenty-mile winds will scar citrus fruit and dry out trees, twenty- to thirty-mile winds drop some fruit, and stronger winds usually shake off half the fruit and cause tree damage noticeable for several years. Damage was avoided in the Fontana grove, however, because it was protected by two rows of staggered bluegum eucalyptus which reduced the wind's velocity seventy per cent, to a harmless fourteen miles an hour.

This is but another instance of sound farming practice going hand in hand with profitable operation. Windbreaks and shelterbelts are not only sound practice but they seldom fail to raise farm income.

Their principal value is in keeping the topsoil down on the farm by protecting it from wind erosion. Windbreaks were planted for this purpose in Nebraska as early as 1854. Nine years later Kansas became the first state to offer a tree bounty, and the Dakota Territory soon followed with tax-exemptions for settlers planting windbreaks.

The real father of windbreaks and shelterbelts in the Great Plains region, however, was J. Sterling Morton. He founded Arbor Day in Nebraska in 1872, and a year later, as the Third Secretary of Agriculture, he encouraged passage of the Timber Culture Act. Probably only a third of the trees planted during the eighteen-year life of the act were for tree bounties, but the stimulus it gave to the establishment of windbreaks was tremendous.

A similar role was played in the southwest by a less widely known figure, Ellwood Cooper of Santa Barbara. Among the 50,000 specimens of trees on Cooper's ranch were eucalyptus that had earlier been introduced from Tasmania. Cooper wrote a book in 1876 to promote the planting of drought-resistant eucalyptus trees in California to control the shifting soil and provide fuel in

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A view of a twenty-acre Nebraska field which is completely enclosed by windbreaks and protected from winds.

Windbreaks Increase Farm Income *Continued*

a region of scant trees and no coal.

The shelterbelts stretching 1,500 miles from the Canadian border to the Texas Panhandle are a monument to Morton in the same sense that the 2,000 miles of graceful eucalyptus trees protecting California citrus orchards and vineyards are a monument to Ellwood Cooper. These monuments, however, are much too small. Shelterbelts at present protect but two per cent of the Plains region! The 270,000 trees already planted on 70,000 farms are insufficient to control dust storms, though they usually preserve the soil on many individual farms. During the 1934-35 dust storms, it took a twenty-five-mile wind to cause severe wind erosion. *And then only if the wind had an extensive sweep.* Shelterbelts break that sweep. It is significant that the higher the velocity of the wind, the greater the reduction of its velocity by an effective windbreak and the farther out into a field is its effect felt.

Illustrating this was a fifty-mile wind which struck a South Minnesota field while the corn was in the milk stage. The farm was protected by a windbreak eighty rods long and twenty-eight feet high which gave complete protection for a distance of ten rods. Beyond that strip, however, half the corn lay grounded, and the badly bent remainder yielded but a third of the normal crop. A two-acre windbreak in this case allowed its owner to harvest a full crop of 260 bushels from the protected six acres.

No trees are high enough to check the storms brought about by the movements of great air masses which flow toward low-pressure areas. Neither the Canadian forests nor the forested mountains of Washington, Oregon and Northern California, for example, halt the southward sweep of the storm fronts, thousands of feet high, passing over them.

Shelterbelts nevertheless prevent storm damage to soil, crops, livestock and buildings if they are placed as a barrier to the prevailing winds. These winds blow from the south in the Great Plains region, and from the north on the Pacific Coast. Topography as well as the direction of the prevailing winds must be considered in laying out a belt of trees. You find California citrus groves in the lee of east-west ridges which need no northern wall of trees. Yet if the same grove lies in a valley open to the sea or the Coastal Range, east or west windbreaks may be needed.

While windbreaks have no effect on the upper air currents, they create a frictional drag on the lower masses of air. Ground currents are diverted upward by a line of trees, and though they soon turn downward again, a pool of quiet air has been left behind. Generally a quarter of the pool lies to windward of the shelterbelt, and three-quarters on the

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A ten row, ⅝ mile long shelterbelt planted on a Nebraska farm in 1940.

sheltered lee side. Since each wall of trees has the same effect, a large number of windbreaks in any one district appreciably reduces local storm damage.

This pays off not only in larger crops but also in quality. An eight-year-old shelterbelt helped Ernest Fuhram of Norfolk, Nebraska, win the 1947 award for corn yield. Fuhram's best corn and the heaviest yield was near the trees, tapering off both in quantity and quality as the distance from the windbreak increased.

In a government survey, 323 Nebraska farmers estimated that windbreaks increased their income by an average $67.15, while 260 South Dakota farmers estimated that tree breaks increased farm income by $84.43. Facts backed up their estimates. On some farms little or no corn was fired for an average distance of 23 times the height of the shelterbelt. A tree wall retarded evaporation of moisture from the soil by the hot, dry southern winds to such an extent that alfalfa could be grown at Scotts Bluff, Nebraska, with one less irrigation a year than on an unprotected farm. Windbreaks again paid off by trapping snow in the fields, rather than allowing it to drift into ditches and low places. Government samplings showed two-and-one-half inches more moisture in the top four feet of windbreak-protected soils.

Orchards benefit as much from windbreaks as field crops. Dr. Arvil L. Stark, Secretary of the Utah Horticulture Society, offered an explanation of why fruit won't set well on the windward side of fruit trees when he pointed out that bees pollinating the blossoms won't work where they are wind-blown. Bees protected by a windbreak, however, pollinate all sides of a fruit tree.

Without protection, orchards are subject to losses from soil drift, blowdowns, evaporation of soil moisture, and wind damage arising from loss of blossoms, leaves or the firing of fruit. Yet in earlier days these losses sometimes seemed preferable to losing the benefit of the acreage occupied by a tree belt. In reality, the production of protected orchards is usually greater than if the whole farm were planted to fruit trees. In a study of twenty citrus groves in Orange County, California, for example, the orange groves with windbreaks yielded $445.48 an acre, and those without $271.34. Using one out of ten acres for windbreaks, an orange-grower came out with $1,295.92 greater return on the nine acres than on ten left unprotected!

The majority of California farmers are convinced of the value of windbreaks. It is not uncommon to see a double row of staggered bluegum eucalyptus reaching across the northern boundary of a farm, and single rows of the same tree or the smaller redgum, desertgum, graygum or the dwarf bluegum eucalyptus shielding the east, west and south sides. On longer north-to-south farms one or more rows of Monterey or Arizona cypress sometimes further subdivide citrus, walnut or avocado farms to keep damaging winds aloft. Cypress canker and other diseases,

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Clean tillage in windbreaks pays dividends in fast early growth.

Windbreaks Increase Farm Income *Continued*

however, are causing the native cypresses to give way to the domesticated eucalyptus.

Large forests have a distinctly cooling effect felt even beyond the tree areas, but shelterbelts are never extensive enough to accomplish this. Since a belt of trees can temper the heat or cold in a limited area, however, it is important to decide in advance just what ends are to be served. South of a dense windbreak the soil may be thawing from reflected sunlight at a time when open fields are frozen solid. While the south side of such a belt might be an ideal location for a house or livestock in winter, it might be too warm in summer. That would depend upon the prevailing summer wind. It is well to remember that a dense bank of trees will stagnate the movement of air, raising the temperature about a degree higher on the lee than on the windward side. That snow will also drift against a thick windbreak is likewise worth remembering; houses and barns might be surrounded by drifts if located less than thirty feet from such a belt.

By tempering the cold, a well-placed windbreak in the north can reduce heating bills and increase the weight of livestock. In an experiment conducted near Holdrege, Nebraska, by the Great Lakes Experiment Station it was found that fuel savings of as much as 30% were effected in homes protected from the wind; the average reduction in fuel bills in South and North Dakota and Kansas, however, was a smaller 20.2%. The Montana Agricultural Experiment Station at Havre wintered two herds of cattle on identical rations; the herd protected by trees and shrubs gained 34.9% more pounds during a mild winter and lost 10.6% fewer pounds in a severe winter than the herd in open lots, which burned up much of its food to maintain body warmth.

The stagnation of air caused by dense windbreaks does not increase frost damage on dead-calm nights. But such windbreaks do prevent the movement of air when the wind is stirring. For that reason, California and Arizona citrus-growers prefer single- or double-rows of alternately-spaced eucalyptus for windbreaks. They prevent storm damage by winds, while allowing air movement during periods of freeze.

In summer the thick top foliage of these trees forces the heavier, cooler air groundward, where it circulates between the bare trunks, moderating the temperature for field and fruit crops, for livestock and homes.

Clearly, a windbreak can be used to modify local temperatures, either to provide greater warmth in a northern winter, or less heat during a southern summer. But a carelessly placed or wrong type of windbreak can make conditions worse in both seasons.

Windbreaks furnish fence posts and fuel for a farm when thinned, and sometimes wood for sale as well. The fast-growing bluegum eucalyptus is particularly valuable in this respect, for it grows fifty to sixty feet in ten years, and as much as eighty feet in twenty. If planted thickly in the beginning, it will provide a constant supply of posts and firewood, the first trees topped being ready for a second cutting by the time the last trees have yielded their harvest. Certain trees, such as the black walnut which grows well in the Corn Belt, supply another source of income in their nuts. And where thick five- to seven-row shelterbelts are desirable, berries can be planted to thicken the belt and furnish a small amount of fruit.

Primarily, however, a windbreak should be considered a protection to crops, livestock, farm buildings and homes, and not a source of income in itself. Excessive thinning which leaves breaks in the wall of trees defeats its original purpose. Such gaps, whether from too much cutting or through failure to replace trees that have died, act as miniature wind tunnels. Funneled through small openings, the wind actually has a little greater velocity than in an open field, and it is capable of more mischief.

Both fire and livestock can destroy windbreaks. While it may seem desirable to allow cattle access to a shelterbelt during hot weather, grazing is usually poorer under trees. Cattle reduce the value of a windbreak by browsing on the lower branches, and their trampling seals the soil and injures roots so that trees get less moisture during periods of little rainfall. Chickens and swine are even more destructive, disturbing the leafmold that retains moisture around the trees. It pays to fence out both livestock and poultry; if they need shade, open-sided *ramadas* can be built with broken or thinned-out branches.

Windbreaks should not be planted haphazardly. Thought must be given to the choice of trees, to the placement of a belt, the moisture available, cultivation, and the purpose to be served.

Of the hundred varieties of trees that have been tried in windbreaks, many were not adapted to their locations. Some were too brittle, while others lost their leaves in winter or were in other ways undesirable. Usually it is wise to buy stock from locally grown seed, and results are better if small, straight trees are selected.

Soil should be well prepared and moist before planting. Subsoiling is advisable on sandy soil. A single man, carrying trees in a tray or bucket covered with wet burlap, can often plant fifty to 120 trees an hour. A farmer with a tractor and two assistants can jump this up to 350 to 500 trees an hour. A thousand trees an hour is possible if about $175 is expended on having a local blacksmith make a tree-planter.

Trees, shrubs and vines that have done well in the Great Plains include the Chinese and American elms, blackberry, honeylocust, cottonwood, white and golden willows, boxelder, chokeberry, Tartarian hon-

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Let Organic Farming Prove Itself

Give it a try–you'll like what you see.

By WM. P. COLEMAN

"I CAN'T be bothered with organic farming," said an impatient truck gardener. "Haven't you heard that it takes nature a million years or something like that, to make one foot of top soil? In this business, you either get results in a hurry or you miss the boat."

He said that it was getting more difficult as time went on to get bumper crops. He planned to increase his applications of fertilizer this coming season and hoped only to keep up production.

"The seasons are changing," he explained, "and we don't get rains when they are most needed. We don't have the hot, humid nights as of old, either."

I saw the results of his shot-in-the-arm farming practices. He depended on fertilizer to do the whole job in spite of the fact that cultivations were so frequent, the weeds never got beyond the seedling stage. With no vegetable matter or manure added, the organic matter had been cropped and cultivated out of the soil. A moderate rain would leave his gentle slopes criss-crossed with shallow gulleys the width of wagon tracks.

"I don't own the place," said the truck gardener, "I just rent it. Been farming it now for about seven years."

The man who bought the place and farmed it the next year, has a poor opinion of his predecessor. Where the truck gardener last had squash and pumpkins, he put in a few rows of potatoes, set out an acre of asparagus and seeded the balance of that field into sweet clover. The soil packed very hard in dry spells.

"On an adjoining piece of ground that is now part of our front lawn," said the new owner of the place, "I set out strawberries. A week or so later when the weeds were just showing, I went in with a horse and a five-shovel cultivator. I was dismayed to see the shovels skid on the hard packed surface even after balancing two heavy rocks on the cultivator. We had to abandon the strawberry patch.

"Some time later when rain softened the ground, I lost no time in transplanting the strawberries to a more congenial soil. The field was then seeded to alfalfa and for the next two seasons we permitted a neighbor to pasture a cow on the luxuriant growth.

"In 1946, we put up our house and now that this small alfalfa field was part of our front lawn, we asked the neighbor to pasture his cow elsewhere. Alfalfa and June grass grew to a height of two feet, so I went at it with a scythe. I cut it often enough to keep growth around six or eight inches.

"We had a long trench running houseward from the water main in the road, carrying our water pipes, and depth of the trench ranged from three and one-half to over six feet. We had shoveled a foot or so of dirt on the pipes to make sure they didn't freeze next winter, and then forked in the heavy alfalfa and grass cuttings.

"A large black walnut stump, measuring about three by three feet was rolled into the trench and covered with cuttings. Just last summer I noticed that the trench had settled and part of the stump was exposed, so I got it up for an examination. In three years it had become mostly spongy wood that crumbled under a few blows of a grub hoe. Just a mere skeleton is still very hard. The stump is slowly but surely going back into the soil.

"In the summer of 1949 we discovered angle worms in the ground. We had never noticed them before. Grass that formerly was more yellow than green and burned up at every dry spell, now is a rich deep green of thrifty growth. The soil that once was powdery dry from the surface down, now holds moisture, thanks to fine alfalfa and grass cuttings and a scattering of fallen leaves that were allowed to lay."

This man set out a few plum and pear trees two years ago right where he had earlier planted strawberries. The trees are less than twenty feet from an old diseased apple and

Let Organic Farming Prove Itself

Continued

cherry orchard, yet the young trees which have never been sprayed show no indications of disease and are making a nice growth.

"Ever since the trees were planted," he said, "we spaded in some of the lawn cuttings around the roots. Sometimes instead of spading, we left the cuttings as mulch. Worms are plentiful under the trees and you can run a spade into the ground with ease any day of the year except when the ground is frozen. Remember, this is the very spot where only a few years earlier, a stone-weighted five-shovel cultivator wouldn't even scratch the surface.

"Two years ago we had more cuttings from the lawn than the trench would accommodate, so we tossed the surplus over the fence on a field that had been taken over by rag weeds. I planned to burn the heaps, which measured about four or five feet across and a foot or more in height, but we got rain just often enough to keep them damp. Within a month or so, we had a string of these heaps.

"Then suddenly I noticed that the growing ragweeds which had averaged about one and one-half feet throughout the field, were at least another foot taller in a broad circumference around each heap. They were of more sturdy growth and a deeper green. I realized then the speed with which vegetable matter decays even above ground and gives out plant food to the surrounding soil.

"This field was put into pickles as a cash crop the following June. Where the cuttings had been heaped, the yield was spotted but fairly good, but the crop in other parts of the field was poor. If we had more organic matter in the field, I believe results would have been excellent. I know now that I should have plowed under the ragweeds; perhaps this could have been done twice in the season.

"All this is proof that the man who hasn't time for organic farming is only kidding himself. It doesn't take long to see results, and everything you can add to the soil whether it is only field cuttings or tons of green, growing crops will make a richer soil."

Why not help your doubting neighbor to prove to his own satisfaction that organic farming will prove itself? He can make the test in a weed-infested field or in a field of small grain, and within a few short weeks he will be amazed at the results that come when man intelligently teams up with nature.

The test can be made at any time, but it is best to do it when weeds or small grain have attained full growth. Then the results are indisputable. Drive a half-dozen or so wooden stakes around in a circle or square inside of which you will heap the cuttings. The stakes should be driven just far enough into the ground so their tops mark the height of surrounding weeds or small grain.

You may not notice any sign of decay in the heap unless you disturb the pile. But after a few weeks you will notice the weeds or small grain adjacent to the heap are growing beyond the tops of the stakes. Even further growth will come more rapidly as the heap decays and releases plant food to the roots.

That should be proof enough for anyone who wants to make a quick test. Something has added growth and color to the surrounding vegetation, and certainly the stakes can not be classified as commercial fertilizer or barnyard manure.

Since I made that test for myself, nothing is ever burned on our place. Branches, leaves and nuts from a row of huge black walnut trees that borders one of our fields, are permitted to decay and return to the soil. If the branches are large enough to tangle in the teeth of the spring tooth drag, I chop them or break them into small bits, and then disc and harrow right over them. They disappear into the soil usually before the season is over, and we have noticed that the soil is becoming more mellow each year.

We had to hire the work done during the first few years on this place because we lacked tools and power. We had the same man each season, but could never get him to come back and cultivate. As a result of discing and dragging the largest asparagus field and then leaving it, the field became heavily infested with quack grass. You could see the asparagus from a short distance in the spring when it came through the ground. Then, the quack would grow a good two and one-half feet and hide the crop until October when the tall asparagus plant turns yellow and can be distinguished among the quack grass greenery.

Last March we received delivery on a new light tractor and I disced the field enough to cut up the sod and the dead asparagus tops. Then I hooked a spring tooth harrow to the tractor and began a program of three deep harrowings each week, each time in a different direction. Many quack roots were as thick as a lead pencil and from four to five feet long. They bunched up under the harrow making it necessary to stop almost constantly to clean the teeth.

Sometimes I despaired of being able to finish the undertaking, because most of my time went for clearing quack roots from the harrow teeth. It went on like that for weeks, then suddenly the roots became very dry and brittle and they broke under the harrow. Soon I could drag all day without once having to clean the harrow teeth, and I saw the tiny bits of quack roots sifting through with the soil.

I maintained this program from the last week in March until the middle of June, solely with the intention of eradicating the quack. The asparagus crop had to be sacrificed and every day the harrow knocked off choice tips above and below the ground. It would be impossible to estimate the loss as we

(*Continued on page* 51)

Accomplishment in Soil Building

The Morrow Plots have shown that it is possible to produce high yields without chemical fertilizers.

By H. J. SNIDER

A LONG term experiment at the University of Illinois has demonstrated graphically that high yields *can* be obtained without shocking the soil by using chemical fertilizers. The results of this experiment, conducted on the Morrow Plots, should be studied by all farmers.

Over the years, the Morrow Plots have shown that the use of manure, limestone and rock phosphate in a rotation containing a legume will produce bountiful crops that are rich in protein.

Three systems of farming were used in the original plan. On one section corn was grown continuously. On another corn and oats were grown in rotation. On the third a rotation of corn, oats and clover was used. These particular cropping systems have been used on the same land for over three-quarters of a century. It was not until less than fifty years ago that the use of limestone and rock phosphate was begun.

Acre yields have shown the value of the corn, oats and clover rotation. In 1949 the plot yielded 68 bushels —and without the use of any fertilizer. In the corn—oats rotation the acre yield was 25 bushels, and with continuous corn the yield was only 16 bushels. There was a difference of 52 bushels between a good rotation and the ruinous practice of planting continuous corn. The leguming system put in operation by Professor Morrow produced 325 per cent more corn than the plan of growing corn continuously.

These Valuable Plots Are The Work of George E. Morrow

George E. Morrow was a professor of agriculture at the University of Illinois after the Civil war. Naturally, he was keenly interested in agricultural progress at that time and had observed the methods of the pioneer farmers. He knew that if some of their cultural practices were continued over a period of years the fertile prairies would be robbed of a large part of their natural fertility. The early settlers seemed to consider that the dark colored prairie land would never wear out and proceeded to build their farm operations around this idea. Professor Morrow realized the danger of this attitude and set about to the task of teaching and demonstrating to farmers some of the better methods of conserving their great wealth of soil fertility.

In that early day Professor Morrow was the Agricultural college, the Experiment Station, the Extension Service and the Soil Conservation Service all rolled into one. He spent 17 years at this momentous task and as a result of his pioneer efforts we today have that valuable strip of land on the University campus known as the Morrow Plots.

Something New Was Added

About the turn of the century Dr. Cyril G. Hopkins took charge of Illinois agronomy work, including

Accomplishment in Soil Building *Continued*

all soil and crop experiments. Because of campus expansion Dr. Hopkins had to rearrange the Morrow plots, but he was able to retain the original plan and to add some advanced ideas. Hopkins' plan got underway in 1904 and included the addition of limestone, manure, steamed bone meal and raw rock phosphate to the fertilization program of the plots. In later years steamed bone meal became scarce and expensive and its use for soil improvement was discontinued. The use of finely ground rock phosphate was continued. In that early day Hopkins wrote, "Steamed bone meal and raw rock phosphate are natural products and they have absolutely no injurious effects on the land."

Hopkins' Plan Increased Production

The Hopkins' plan of permanent soil fertility worked wonders in the production of corn, oats and red clover when added to Professor Morrow's legume rotation. In 1949, after 45 years of operation, the corn yield was 104 bushels an acre in spite of drought and corn borer injury. This 104 bushels yield was obtained on the land with a legume in the rotation along with manure, limestone and rock phosphate. The land where the continuous corn was grown in 1949 yielded only 16 bushels an acre. This was a gain of 88 bushels, or on the percentage basis was a gain of 550 percent. Apparently such a drop in corn yield is what Professor Morrow anticipated back in the seventies. A Hopkins' plan of soil building has proven to be very effective after 45 years of trial. Manure and legumes maintain the organic matter, limestone helps to grow better legumes, with finely ground rock phosphate supplying phosphorous to all crops.

This system of soil improvement has proved itself in another way. It frequently happens that as yields go up the quality of the crops goes down. On the Morrow Plots the fertility of the soil has been sufficient to maintain high quality in the crops along with high acre yield. In the continuous corn system the grain contained 437 pounds of total protein per 100 bushels of grain. On land where there was clover in the rotation and the land was treated with manure, limestone and rock phosphate, the corn contained 582 pounds of protein per 100 bushels of grain. This was a gain of 145 pounds of protein or nearly 1½ pounds per bushel of corn.

The Oat Yield More Than Doubled

The oat crop also responded to the legume, manure, limestone and rock phosphate treatment. Under this system the oat yield was 72 bushels and the grain contained 14.6 per cent protein. In the corn—oats rotation, where the land was untreated, the oat yield was only 30 bushels an acre and the grain contained 12.1 per cent protein. The acre yield of protein from the treated land was 335 pounds of total protein per acre and from the untreated land 116 pounds. The treated land produced nearly three times the total feeding value in the oat crop as compared to the untreated land.

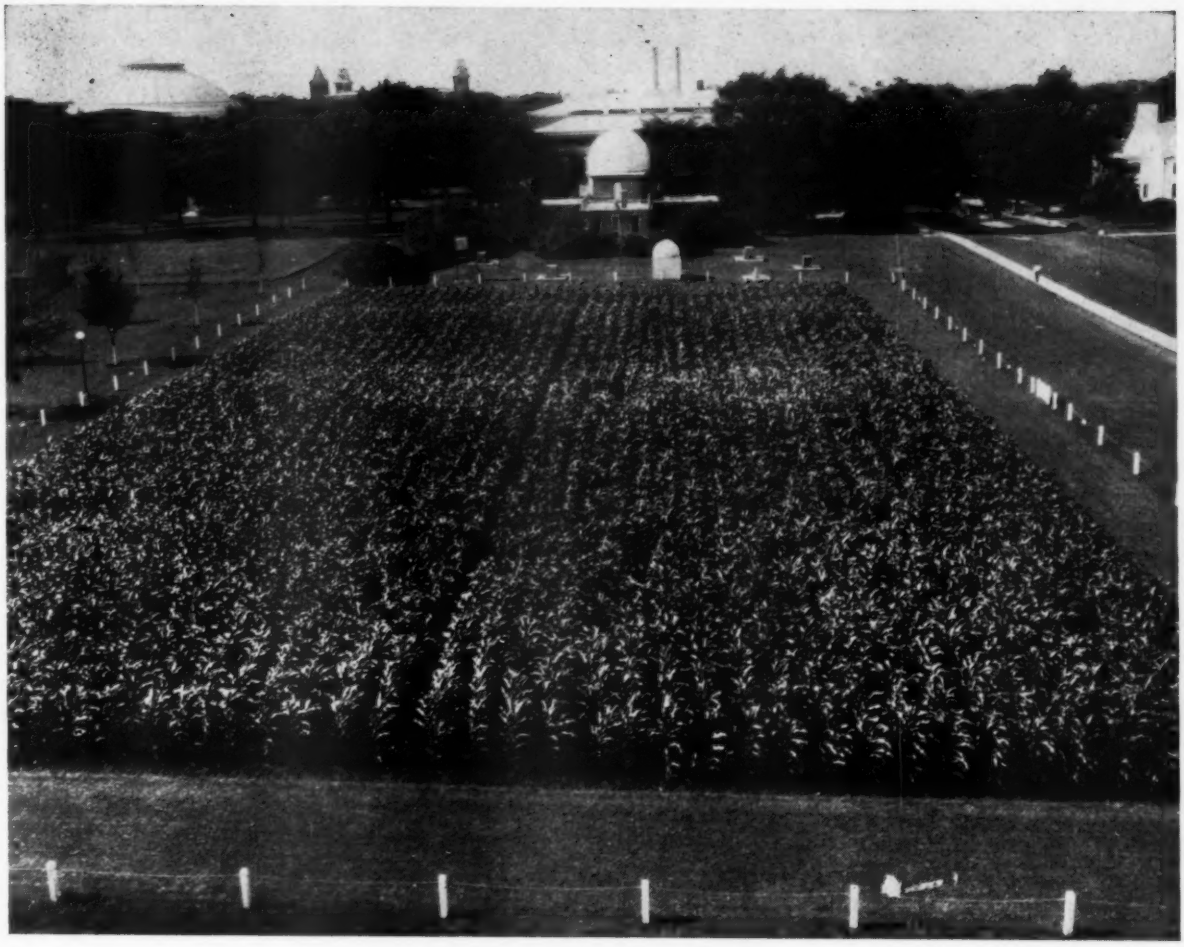
Red clover responded remarkably to the Hopkins system of soil treatment, both in acre yield and quality. The acre yield on the treated land amounted to 6940 pounds of hay and on the untreated land the yield was 3260 pounds. This was a gain of 3680 pounds of hay an acre. The red clover grown on the land treated with rock phosphate contained from 3.4 pounds up to four pounds of phosphorus in a ton. The clover grown on the untreated land was deficient in phosphorus as it contained only 2.4 to 3 pounds per ton of dry hay. These are amounts which indicate a shortage of this element.

Organic Matter in the Soil Maintained

One system built up the organic matter in the soil, the other destroyed it. One led to soil depletion and ultimately to low crop yields. The other system restored the organic matter, replaced elements removed by cropping and led to high yields and a permanently fertile soil. The land receiving a treatment of legumes, manure, limestone and rock phosphate now contains 53.7 tons of organic matter in the top soil. This land produced large crops and these crops were removed each year. The continuous corn robbed the soil and depleted the organic matter down to 28.7 tons an acre. This was a loss of 25 tons of organic matter from the top soil.

The Hopkins' Plan Extended

Dr. Hopkins was an agressive and a tireless worker. He established field experiments which elaborated on the original Morrow Plots. These fields were located at various points in the state and demonstrated to farmers two systems of replenishing and building up organic matter in their soils. For the livestock farmer, manure was used on the basis that for each ton of crop removed from the land and fed there might be a ton of manure returned to the soil. For the strictly grain farmer, and Illinois has many, he demonstrated the crop residue system of replenishing organic matter. The residue plan involved the return of all stalk and straw with a special effort to turn back legume crops for soil improvement purposes. These field tests demonstrated the feasability of maintaining organic matter in soils through the use of either manure or crop residues. The manure system has, through the years, shown a slight edge on the crop residue system. It did, however, demonstrate to the very large number of grain farmers in Illinois that they can maintain and probably build up the organic matter in their farm land through the use of legume and other crop residues.



The Morrow Plots at the University of Illinois.

Rock Phosphate

Dr. Hopkins was a strong advocate of the use of finely ground raw rock phosphate to build up a supply of phosphorus in soils. His chief claim in its favor was its high phosphorus content and its relatively low cost. Phosphorus in the form of rock phosphate could be added to soils in large quantities and at lower cost than in any other form of fertilizer. During Hopkins time large quantities of rock phosphate were delivered at Illinois railroad sidings at a cost of $5.00 to $7.50 per ton. The price depended on the length of the freight haul. Each ton contained at least 250 pounds of phosphorus. At the prevailing prices phosphorus then cost less than three cents per pound. This element Hopkins frequently referred to as the key to permanent systems of agriculture.

Farmer's Accepted Permanent System

Farmer's accepted Hopkins' ideas and recommendations regarding the use of rock phosphate and large quantities were used. The late Frank I. Mann of Gilman, Illinois, was an advocate of Hopkins' plan, and began the use of rock phosphate on his farm in 1906. So convinced was Mr. Mann of its profitableness that in the course of several years he applied as much as four tons an acre to his crop land.

The early experience of John C. Mies, of Livingston county, was typical of many farmers. Mies used a few tons of rock phosphate as early as 1906 and after hearing Dr. Hopkins talk at a Farmer's Institute meeting he said, "I now had no doubt about the benefit of raw rock phosphate. During the fall of 1913 I applied three carloads of over 120 tons and in 1914 five carloads of over 200 tons more, so that by the beginning of the spring of 1915 I had applied one ton per acre to the entire 320 acre farm."

Illinois farmers spread on their crop land nearly three quarters of a million tons of finely ground rock phosphate in the single year of 1947. Figures available for the first six months of 1948 indicate the use of half a million tons in that time.

Three Bales on One Acre

That's how much COTTON one organic farmer raised.

By H. E. DOLAN

HERE in this great land of ours where we enjoy freedom of thought and expression; where competition is encountered in every line of endeavor, it is not surprising to find differences of opinion in politics, religion and other walks of life, including agriculture.

The argument for organic or natural fertilization as opposed to chemicals has been cogently presented by able men of the past and present. Their contentions have been proven in experiments. Unfortunately, their work has, to a great extent, been submerged by the many forces advocating artificial fertilizers.

Now it seems Nature has taken a hand in the controversy. All over the nation, especially here in the south where the winters are mild, insects and diseases are taking an increasingly larger toll of each year's harvest. Last year the loss from boll weevils alone in Georgia was estimated at $40,000,000.

The following is from an editorial in *The Atlantic Constitution* of October 31, 1949:

"Cobb County's cotton farmers, who last year produced about 5,000 bales, will this year produce about 400. Their bills for fertilizers, for poisons and labor were the highest in history.

"Cobb County has, under existing regulations, been classified as a "disaster area" and farmers will be eligible for Federal loans."

While these farmers wait with fear and trembling to see what the weevils and weather will do to their crops, let us go to the files of the Dept. of Agriculture for the story of a man who had no fertilizer, no machinery and no government to lend him money when his crop failed, but who did have Mother Nature, the greatest of all forces, on his side.

Along the right-of-way of the Southern Railway from Atlanta to the Tennessee line, over which this writer travels daily, the cotton farmers, almost without exception, are following the same procedure this year that wrought such havoc with their last crop. Black spots in the fields indicate where stalks, weeds and grass were raked up and burned. Creek banks, fence rows, terraces and woodlands covering thousands of acres have been burned to the bare earth. Where plowing is finished the fields are dotted with white sacks of fertilizer to be dumped into tractor- or mule-drawn spreaders. "There are none so blind as those who will not see."

The reference is to a bulletin issued a good many years ago setting forth the methods of a Negro farmer of Alabama who produced cotton, corn and other field crops so far in excess of present yields as to seem fantastic and unbelievable. This Negro, Sam McCall, an ex-slave, seventy-five years old at the time, had been earning a comfortable living for twenty-one years on two acres of

land. Practically all ex-slaves were illiterate and the chances are if someone had mentioned high analysis fertilizer, superphosphate or trace minerals to old Sam he wouldn't know what they were talking about. Yet he got results that modern mechanized and super-fertilized farms have never been able to equal.

In this section the average cotton production was one-third of a bale to the acre, and the bulletin states that, much of the land had been abandoned by the so-called better class of farmers. McCall had no help and no machinery except one-horse implements common to that section. On every page of this bulletin sentences are underscored emphasizing the fact that this farmer used no commercial fertilizer whatever except a little cottonseed meal under his oats.

The secret of Sam McCall's success is revealed in this paragraph which is reproduced verbatim, including the underscoring.

"Improvement of this land was begun by increasing the organic content of the soil. At first this was accomplished by plowing under leaves and other decaying vegetable matter secured from the nearby woodland, but this practice was later discontinued. Cornstalks, cotton stalks, and all weeds from the fence corners were plowed under, but *never burned,* as is the common practice in many portions of the South. Practically everything but the lint cotton and a portion of the seed was returned to the land in some form or other. *The manure produced by his horse and two cows was carefully kept,* but as the latter were out at pasture the greater part of the year, the *quantity* saved was *not large.* Ditches were also constructed from the stable lot, so that when it rained *any leaching from the barnyard would be carried to the field,* where it could be utilized by the growing crops. *No commercial fertilizer of any kind was used, except a little cottonseed meal under the oats."*

By simply increasing the organic content of his soil, McCall was able to raise cotton production from one-third of a bale per acre to seven bales on two acres, or about ten times the average yield for his section. Contrary to popular opinion, that cotton wears out the soil, he was able to obtain these high yields year after year. And selecting the seed from his best plants he produced a 506 lb. bale on a measured one-eighth of an acre.

One year the entire two acres were planted to corn, producing 320 bushels. Another year one acre was planted in oats followed by cotton. The yield was 75 bushels of oats and three bales of cotton weighing more than 500 lbs. each. The same year the other acre produced 50 bushels of oats, 50 bushels of corn and a bale of cotton weighing over 500 lbs. In comparison with neighboring farms it is stated that: "The gross annual income from this 2-acre farm . . . is far above that obtained by the average tenant farmer who cultivates from ten to twenty times as much land."

Probably anticipating doubters and skeptics the writer of this bulletin added a paragraph attesting to the authenticity of his story. He says, ". . . . no books were kept by the owner of this farm, but, being possessed of an active mind and a remarkably keen memory for facts and figures, he unhesitatingly gave exact weights of bales of cotton and yields of corn produced several years back. To test the correctness of these figures, a number of visits extending over a period of two years were made to his farm and on every occasion the statements made as to yields and other records for the different years corresponded exactly with those given on the first visit."

Here is prima-facie evidence from the files of the Department of Agriculture that commercial fertilizers are unnecessary in building up worn-out land, obtaining and continuing high production year after year. Every farmer should be given a copy of this bulletin and told to go and do likewise.

Keep a Soil Bank Account

By Benjamin Manz

YOU wouldn't think of putting money in the bank without having the cashier record it, would you? Yet that's probably just what you do when you deposit manure, lime, phosphate, and compost in your soil bank. Why not keep an account this year, not only of deposits, but withdrawals (yields) and tillage practices as well.

All you need to keep this record is a notebook, preferably a looseleaf one. Each field should be numbered for handy reference.

Keep a map of your farm in your "account" book and you will always know the field numbers at a glance. Give each field a page (both sides) in the record. By using a looseleaf book you can add sheets as needed.

The records should be kept by the year, but make the year suit your farm. March first to March first will fit many farms. It is best to break years when work on the new crops begins. Of course, the fiscal year will vary with the individual setup.

To get an idea on how to keep your records, look over this sample.

Field No. 5 — 12 acres

1949 *Crop* — Oats, clover

Seed — Clinton, Mammoth Red

Tillage — Disked twice in spring.

Soil Treatment — 500 pounds per acre rock phosphate drilled with oats. Two tons ground limestone per acre spread after oats harvest. East half covered thinly with cow manure in fall.

If you keep records like this you won't have to ask yourself what crop a field grew five years ago, or when you limed it last, or any of the other thousand and one questions that spring up annually. You can turn to your soil bank account book for the answers. What's more, it's a good idea to keep a credit balance in your soil. It's money in the bank.

Report from Britain

Production And Soil Fertility

By L. F. EASTERBROOK

Agricultural Correspondent of The London News Chronicle

IN A sense it may be said that all Britain's farmers practice mixed farming for since turnips and clovers were introduced in the 17th century, the prevailing idea behind a complex variety of systems has been to use livestock to put back into the soil the fertility taken out by crops. In this way Britain has escaped those forms of monoculture that have created "dust bowls" and caused so much soil erosion elsewhere.

The traditional farming system is that practised in the main arable areas, the orthodox rotation being barley or oats undersown with one-year seeds on which stock is fed. The seeds are then ploughed for wheat, the wheat is then followed by a cleaning crop of roots or potatoes or sugar beet, then barley again and so on. The theory is that the crops provide the straw for the animals to tread into dung in yards in the winter. The dung provides fertility for yet better crops to keep more animals, or for wheat for human consumption, with oat straw as a by-product to increase the supply of feeding stuffs.

High Costs Problem

This system of "putting back into the soil what you take out" is, however, being modified by several factors. The first of these is high labor costs. Recent investigations have shown that the costs of yarding cattle or folding sheep over arable land are so high as to be unprofitable, even when the value of their manuring is taken into account. So the yard-fed cattle and the arable sheep flocks are disappearing. We still carry out dung from the cowsheds of the dairy herd, also from the pig houses on farms. But we are turning more and more to systems of "ley" farming under which the animals themselves can be used as "muck-spreaders." Ley farming has also affected the non-arable areas as well and has turned many of those farmers into "mixed farmers."

How does ley farming operate? Thanks mostly to improved strains of grasses and modern machinery, we can now make in months, pasture that required as many years to bring to such a high standard of excellence. We still have of course, much to learn about it, especially in the selection of the assemblage of grasses to suit different areas. But it can be put down, say, in April or May at a cost of £10 ($28.00) to £14 ($39.20) per acre and grazed in June. Very soon it will be as productive as the best permanent pasture. By proper management we can extend its grazing season by about a month at each end and it will stay at a high pitch of productivity for three, four or five years, perhaps even more in some instances.

Rising Fertility

The farmer ploughs up the grass again when it suits him. On good land this may be after its second or third year, but on poor land it may profitably be kept down seven or eight years, or even longer. The beauty of the system is its flexibility. The farmer ploughs it and sows a cereal crop—wheat if he can. The high concentration of livestock that the pasture carried, fertilized with all their dung and liquid manure, provides the fertility for the grain crop, assisted by the nitrogen collected by the clovers from the air and stored in their roots. The farmer may well be able to take two successive grain crops, then, perhaps, a crop of potatoes, roots or sugar beet, after which it goes back again into

BRITAIN REPORTS THE EFFECT OF TEMPORARY PASTURE SYSTEMS ON FOOD PRODUCTION.

a temporary pasture, or "ley." This system, we are finding, creates a circle of rising fertility. Better grass means more stock; more stock, more manure; more manure better crops and more food for man and beast. It is all based on grass, a crop which Britain is fortunate in being able to grow to perfection.

The advantages that accrue from sending the animals to spread their dung or get their food instead of transporting these bulky things to and from cowshed and cattleyard, are being followed up in other ways. More poultry are being folded over pastures. Arable sheep flocks are giving place to grass sheep, turned out to graze the leys. Rape and kale are being grazed by cattle with the aid of electric fences instead of that laborious, costly process of cutting the kale and carting it to the stock.

Before World War II, when the world's supplies of feeding stuffs were unlimited, Britain was a big importer, buying about 8,500,000 tons annually to feed the big livestock population maintained on nearly 19,000,000 acres of permanent grassland. Most of this grass was of indifferent quality, but the system paid while feeding stuffs were so cheap, for only the best land in Britain showed any profit under cereal crops. There were large areas of potentially ploughable land where not a plough existed. Men had forgotten how to use one. It could hardly be called a system of monoculture, for no cultivations went on in such areas. But it certainly was not mixed farming, and the best that can be said for it was that it kept men on the land through a bad time in our agricultural history without reducing the potential fertility of the soil.

Position Now Changed

That position has now ended. The feeding stuffs are not there any more in unlimited quantities and we have not the money to buy them even if they were. Instead of 8,500,000 tons imported prewar, we imported last year 3,250,000 tons, and in the same period imports of coarse grains fell from nearly 4,000,000 tons to 1,200,000. We must now, therefore, grow them for ourselves, not only to make up the deficit, but to feed the extra livestock we are keeping under our plan to raise farm production by 1951/52 by 15 per cent above the peak of our wartime output. Five million acres of our permanent pasture have gone into a cropping system. More must follow. It is no longer a question, as in the old days, of increasing our grain crops *or* our live stock. We must increase *both*, and ley farming provides the technique for doing it. So in this way our grassland farmers too are also changing their ways and becoming "mixed farmers."

This does not mean, however, that the farming all over Britain is becoming the same. Conditions are far too varied for that. The emphasis on the eastern side of the country, where it is flat and dry and where grain ripens well and grass "takes" badly in time of drought, is still on grain growing. In the west, where it is wet and hilly, unsuited to wheat and where some years even oats will not ripen on the higher lands, the emphasis is on grass. In between are all sorts of graduations where the farmer, using his local knowledge, must adapt his farming to the circumstances of weather and soil.

A "Truth About Fertilizer" Bill

Legislation is needed to protect the health and welfare of the people

By WM. G. HOLMAN

A FEDERAL Trade Commission Report shows how a few fertilizer manufacturers acquired a monopolistic control of the phosphate rock and acid phosphate market in this country, and Federal Court records show how they have used this control to continually exploit the farmers, and endanger the health of the people.

Eight Members of the United States Senate introduced a resolution on July 20, 1949, requesting an investigation of the monopolistic practices of the fertilizer industry.

This resolution told of the leasing of public lands on which are found the principal potash deposits to a few corporations, and of how this had enabled them to acquire a control of 80 to 90 percent of the potash in this country.

Thus we see monopoly in the saddle—all booted and spurred—and the farmers at the mercy of these corporations.

There is another phase of this matter that is far more shocking.

Fertilizer money is being used to subsidize the research work of the Bureau of Plant Industry, and these gifts of money have resulted in keeping the people in the dark as to the harmful effects of present methods of fertilizer manufacture on the health and welfare of the people.

Is the corruption of public officials today less shocking in its implications than it was at the time of the Teapot Dome Scandal?

House Resolution 207, introduced by Congressman Frank B. Keefe on May 9, 1949, requested the appointment of a Special Committee to study the economic and health phases of this matter, and report its findings and recommendations to Congress, and on August 10, 1949, the Dean of the House, Honorable Adolph J. Sabath, introduced a similar resolution. Both of these resolutions are now resting securely in the House Rules Committee.

Five years ago I wrote, and Congressman William Lemke introduced, a truth about fertilizer bill, and he has introduced this bill at each session of the Congress since that time. It is still in a pigeonhole of the House Committee on Agriculture.

The farmers need a Truth About Fertilizer Law.

This law should require the manufacturer to tell the farmers what materials have been used in making fertilizer, the number of pounds of each material, and the number of pounds of sand or other useless filler. The law should forbid the shipment of fertilizer in inter-state commerce that contains more than 50 percent of water-soluble nitrogen.

The enactment of this law would make it possible for farmers to grow better crops with 50 percent less fertilizer per acre, help to prevent plant diseases, and injury to the health of human beings.

It has been known for a long time that an excess of soluble nitrogen in fertilizers makes all plants more susceptible and less resistant to disease,

but only in recent years has there been any suggestion that food crops grown with an excess of soluble nitrogen are poisonous to farm stock, and injurious to the health of the people.

Men of such eminence as Lyon and Buckman of Cornell University have said that: "Of the three fertilizer elements, (meaning, of course, nitrogen, phosphoric acid, and potash), "soluble nitrogen is the only one which, added in excess, will result in harmful effects on the crops. It may decrease resistance to disease."

Sir A. D. Hall, a man who achieved such eminence in the field of agriculture that he was knighted by the British Government, has told the public in a widely read textbook that: "The association of high nitrogenous manuring with susceptibility to disease may be seen in all plants."

In spite of warnings of these eminent scientists, state fertilizer laws were amended and these amendments permitted the manufacturers, (1) to increase the nitrogen content of all fertilizers 21 percent, (2) to remove from the fertilizer bags what were known as "source tags" which told the farmers what materials had been used in making the fertilizer, and (3) to use almost unlimited proportions of the cheap, water-soluble sources of nitrogen without letting the farmers know that this was being done.

The use of *so much* of the water-soluble nitrogen was soon followed by a scourge of destructive plant diseases that had never given the farmers any trouble prior to the time these radical formula changes were made.

The use of *so little* of the organic sources of nitrogen forced the farmers to use at least 50 per cent more fertilizer per acre in order to get enough organic nitrogen to feed the crops to maturity.

Forcing the farmers to use 50 percent more fertilizer per acre costs them 250 million dollars a year more than would have been necessary if the fertilizer had contained the right proportions of soluble and organic nitrogen, and the ravages of tobacco, potato, and tomato plant diseases cause the farmers to suffer additional losses running into millions of dollars.

These facts should be sufficient to incline the Congress to put an end to a racket of which the farmers have long been helpless victims, but there are other reasons which place a greater obligation on the shoulders of Congress.

Not until recently has there been any suggestion that food crops grown with an excess of soluble nitrogen are injurious to the health of human beings, and poisonous to farm stock.

Dr. James Asa Shield, an eminent medical scientist of Richmond, Virginia, says that people whose food crops are grown with nature's plant food—organic nitrogen—do not have sclerosis of their nerves, their blood vessels, blockage of their veins, or high blood pressure, or kidney or gall stones. He also says that: "People whose food comes from soils fertilized with chemicals appear to have more vascular diseases, and more degenerative diseases."

Dr. Max Gerson of the Gotham Hospital, New York, says that: "The human body lost part of its resistance and healing power as man left the way of natural nutrition for generations. The fundamental damage starts with the use of artificial fertilizer for vegetables and fruits."

Dr. William A. Albrecht, Ph.D., College of Agriculture, University of Missouri, emphasizes the relationship between food and health in the following words: "Our health comes to us, after all, via our food."

Then comes the *Yearbook of Agriculture* 1948, page 288, with the startling statement: "More than 1 or 2 percent of nitrates in plants as a result of very heavy fertilization or of excessive amounts in soils is known to be poisonous to stock."

A survey conducted by experts of the United States Department of Agriculture indicates that highly fertilized pasture lands may be the cause of the X-disease that has killed so many cattle, and forced some cattlemen to give up the cattle raising business.

The Spectator (London), October 17, 1941, said that rabbits have died after eating cabbage grown with an excess of nitrates.

Common sense tells us that anything that poisons cattle and kills rabbits is undoubtedly harmful to the health of human beings, and may be the cause of the great increase in the number of diseases that are taking the lives of our people.

Two fertilizer labeling bills introduced early in the first Session of the 81st Congress are still in a pigeonhole of the House Committee on Agriculture.

These bills are intended to give the farmers information as to the contents of a bag of fertilizer that state laws do not now give them.

One of these bills—H.R. 3045, introduced by Congressman Frank B. Keefe, puts a limit on the soluble nitrogen content of fertilizer shipped in interstate commerce—a necessary provision.

The enactment of this bill will make it easier for state enforcement agencies to see that the farmer gets an honestly made fertilizer.

I think the public is entitled to know how a few manufacturers acquired a monopolistic control of the fertilizer industry, and to what extent they have exerted an influence on officials of the state and federal governments.

An Act of Congress, approved April 10, 1918, entitled "An Act to promote export trade and for other purposes," permitted a few fertilizer manufacturers to form a selling agency combine which controlled practically all of the phosphate rock shipped from this country to Europe. (See U.S. Statutes at Large 40, page 516.)

This combine first secured control of the prices and terms of sale of all phosphate rock sold in Europe by threatening to dump 200,000 tons of Florida phosphate rock on that market each year at reduced prices. (See *Federal Trade Commission Report*, May 1, 1946.)

A "Truth About Fertilizer" Bill

Continued

The almost complete control of such basic fertilizer materials as phosphate rock and acid phosphate enabled this small group of manufacturers to compel other manufacturers in this country to obey their wishes not only as to how fertilizer should be made, but as to what the selling price should be.

Having established a ruthless control of the fertilizer industry, these manufacturers then set to work to have the state laws amended to suit their notions, and their activities in this direction resulted in their being indicted and fined in a Federal court in North Carolina for having exerted an illegal influence on state law makers.

However, the amendments to the state laws that they succeeded in having enacted are still plaguing the farmers, and endangering the health of the people.

With a view to protecting the farmers and the health of all the people, I undertook to do two things: (1) prove with properly conducted experiments that an excess of soluble nitrogen was the cause of plant diseases, and (2) secure the enactment of a Truth About Fertilizer Law that would put a reasonable limit on the water-soluble nitrogen content of fertilizer, and let the farmers know the number of pounds of each material used in making it, as well as the number of pounds of sand or other useless filler.

I knew that if I could prove that an excess of soluble nitrogen was the cause of plant diseases, it would be easy to convince the Congress of the need of the legislation I advocated.

Twenty-six of my experiments conducted in nine counties in North Carolina resulted in the growth of healthy tobacco plants free of disease.

Dr. Earl H. Hall, Professor of Botany of the Greater University System of North Carolina, expressed the opinion that my theory was physiologically as well as logically sound.

Dr. A. L. Grizzard, Associated Agronomist, Virginia Experimental Station, had said that an excess of nitrogen "may cause over-stimulation and a weak, watery growth which is susceptible to disease," and the *Yearbook of Agriculture* 1939, page 413, had said that plants *relatively high in water content* are generally *low in some of the carbohydrates,* and are *particularly susceptible* to attack by fungus and bacterial disease.

Sir Albert Howard, a man who had achieved such eminence in the field of agriculture that he was knighted by the British Government, expressed the opinion in a letter to me that I had hit the nail squarely on the head, and he was in entire agreement with me.

Senators Barkley, Byrd, George, Tydings, and Renolds, and three Southern Governors, requested the Department of Agriculture to give its approval to a Federal grant to me for the completion of my experiments, and a bill was introduced in Congress to accomplish this purpose.

Mr. R. M. Salter, Chief, Bureau of Plant Industry, opposed this bill, and the statements made by him to the Chairman of a Senate subcommittee resulted in an adverse report.

Mr. Salter told the subcommittee that fertilizer had nothing to do with the cause or control of blue mold, and then stultified himself by saying that he had tried to get me to let him conduct tests with my fertilizer formula for the control of blue mold.

Mr. Salter then made two surprising statements to the subcommittee, one of them refuting the other: He said that "several effective and inexpensive control measures have been developed," and then added that "at present $18,000 is allotted to blue mold investigations."

The control measures referred to by Mr. Salter would have cost the farmers of one state $765,000, and, to show that they were not effective, I need only to assert that they are not even recommended today, and the ravages of blue mold are still resulting in enormous losses to the farmers.

Furthermore, if Mr. Salter had found an effective control measure, why did he want to spend any more of the public funds on blue mold investigations?

The statement made by Mr. Salter in a speech that he delivered at the fertilizer convention at Hot Springs, Virginia, on June 25, 1946, indicates that he was already under financial obligations to the fertilizer people, and was appealing to them for additional funds.

This is what he said: "Probably you can spend a little more money advantageously in subsidizing research on special problems through fellowships and grants to states. A little financial oil applied to the squeaks in the reasearch machinery often produces surprisingly good results."

The record shows that Mr. Salter's statements helped to delay the day when the truth would be known that an excess of soluble nitrogen was the cause of plant diseases, and of injury to the health of the people.

Mr. Salter must have known that my theory was logically and physiologically sound, or he would not have admitted in a letter to Congressman Reid F. Murray that "Tobacco plants grown with organic nitrogen can be expected to be higher in starch."

If that be true, then Mr Salter cannot explain away his efforts to keep me from proving it, and the Congress should undoubtedly inquire into his motives.

Could any problem be raised of more importance to the people than one that involves the corruption of public officials, the criminal exploitation of the farmers, and trade practices that endanger the health of both man and animals?

A Criticism of Agricultural Research

By SIR ALBERT HOWARD

From an Agricultural Testament

A WANT of relation between the conventional methods of investigation and the nature of disease in plants and animals has been shown to exist. The vast fabric of agricultural research must now be examined in order to determine whether effective contact has been maintained with the problems of farming.

The application of science to agriculture is a comparatively modern development, which began in 1834 when Boussingault laid the foundations of agricultural chemistry. Previously all the improvements in farming practice resulted from the labours of a few exceptional men, whose innovations were afterwards copied by their neighbours. Progress took place by imitation. After 1834 the scientific investigator became a factor in discovery.

The first notable advance by this new agency occurred in 1840, when Liebig's classical monograph on agricultural chemistry appeared. This at once attracted the attention of agriculturists. Liebig was a great personality, an investigator of genius endowed with imagination, initiative, and leadership and was exceptionally well qualified for the scientific side of his task—the application of chemistry to agriculture. He soon discovered two important things: (1) that the ashes of plants gave useful information as to the requirements of crops, and (2) that a watery extract of humus gave little or no residue on evaporation. As the carbon of the plant was obtained from the atmosphere by assimilation in the green leaf, everything seemed to point to the supreme importance of the soil and the soil solution in the raising of crops. It was only necessary to analyse the ashes of plants, then the soil, and to apply to the latter the necessary salts to obtain full crops.

A New Theory Has Evolved

To establish the new point of view the humus theory, which then held the field, had to be demolished. According to this theory the plant fed on humus. Liebig believed he had shown that this view was untenable; humus was insoluble in water and therefore could not influence the soil solution.

In all this he followed the science of the moment. In his onslaught on the humus theory he was so sure of his ground that he did not call in Nature to verify his conclusions. It did not occur to him that while the humus theory, as then expressed, might be wrong, humus itself might be right. Like so many of his disciples in the years to come he failed to attach importance to the fact that the surface soil always contains very active humus, and did not perceive that critical field experiments, designed to find out if chemical manures were sufficient to supply all the needs of crops, should always be done on the sub-soil, after removing the top 9 inches or so. If this is not arranged for, the yield of any crop may be influenced by the humus already in the soil. Failure to perceive this obvious fact is the main reason why Liebig and his disciples went astray.

He also failed to realize the supreme importance to the investigator of a first-hand knowledge of practical agriculture, and the significance of the past experience of the tillers of the soil. He was only qualified for his task on the scientific side; he was no farmer; as an investigator of the ancient art of agriculture he was only half a man. He was unable to visualize his problem from two very different points of view at one and the same moment—the scientific and the practical. His failure has cast its shadow on much of the scientific investigation of the next hundred years.

Rothamsted, which started in 1843, was profoundly influenced by the Liebig tradition. The celebrated experiments on Broadbalk Field caught the fancy of the farming world. They were so telling, so systematic, so spectacular that they set the fashion till the end of the last century, when the great era of agricultural chemistry began to wane. During this period (1840-1900), agricultural science was a branch of chemistry; the use of artificial manures became firmly welded into the work and outlook of the Experiment Stations; the great importance of nitrogen (N), phosphorus (P), and potash (K) in the soil solution was established; what may briefly be described as the NPK mentality was born.

A Criticism of Agricultural Research *Continued*

The trials of chemical manures, however, brought the investigators from the laboratory to the land; they came into frequent contact with practice; their outlook and experience gradually widened. One result was the discovery of the limitations of chemical science; the deficiencies of the soil, suggested by chemical analysis, were not always made up by the addition of the appropriate artificial manure; the problems of crop production could not be dealt with by chemistry alone.

The physical texture of the soil began to be considered; the pioneering work of Hilgard and King in America led to the development of a new branch of the subject—soil physics—which is still being explored. Pasteur's work on fermentation and allied subjects, by drawing attention to the fact that the soil is inhabited by bacteria and other forms of life, disclosed a new world. A notable elucidation of the complex life of the soil was contributed by Charles Darwin's fascinating account of the earthworm. The organisms concerned with the nitrification of organic matter were discovered by Winogradsky and the conditions necessary for their activity in pure cultures were determined.

Another branch of agricultural science – soil bacteriology – arose. While the biology and physics of the soil were being studied, a new school of soil science arose in Russia. Soils began to be regarded as independent natural growths: to have form and structure due to climate, vegetation, and geological origin. Systems of soil classification, based primarily on the soil profile, with an appropriate nomenclature developed in harmony with these views, which, for the moment, have been widely accepted. A new branch of soil science—pedology—arose. The Liebig conception of soil fertility was thus gradually enlarged and it became clear that the problem of increasing the produce of the soil did not lie within the domain of any one science but embraced at least four—chemistry, physics, bacteriology, and geology.

At the beginning of the present century, the investigators began to pay more attention to what is after all the chief agent in crop production—the plant itself. The rediscovery of Mendel's law by Correns, the conception of the unit species which followed the work of Johannsen and the recognition of its importance in improvement by selection have led directly to the modern studies of cultivated crops, in which the Russians have made such noteworthy contributions. The whole world is now being ransacked to provide the plant breeders with a wide range of raw material. These botanical investigations are constantly broadening and now embrace the root system, its relation to the soil type, the resistance of the plant to disease, as well as the internal mechanism by which inheritance takes place.

Plant Science Has Made Advances

The practical results of the last forty years which have followed the application of botanical science to agriculture are very considerable. In wheat, for example, the labours of Saunders in Canada led to the production of Marquis, an early variety with short straw, which soon covered 20,000,000 acres in Canada and the neighbouring States of the Union. This is the most successful wheat-hybrid yet produced. In Australia the new wheats raised by Farrer were soon widely cultivated. In England the new hybrids raised at Cambridge established themselves in the wheat-growing areas of this country. In India the Pusa wheats covered several million acres of land. By 1925 the total area of the new varieties of wheat had reached over 25,000,000 acres. When the annual dividend, in the form of increased wealth, was compared with the capital invested in these investigations, it was at once evident that the return was many times greater than that yielded by the most successful industrial enterprise.

Similar results have been obtained with other crops. The new varieties of malting barley, raised by Beaven, have for years been a feature of the English country-side; the new varieties of sugar cane produced by Barber at Coimbatore in South India soon replaced the indigenous types of cane in northern India. In cotton, jute, rice, grasses, and clovers and many other crops new varieties have been obtained; the old varieties are being systematically replaced. Nevertheless the gain per acre obtained by changing the variety is as a rule small.

The great problem of agriculture at the moment is the intensive cultivation of these new types; how best to arrange a marriage between the new variety and a fertile soil. Unless this is done, the value of a new variety can only be transient; the increased yield will be obtained at the expense of the soil capital; the labours of the plant breeders will have provided another boomerang.

A number of other developments have taken place which must briefly be mentioned. Since the Great War the factories then engaged in the fixation of atmospheric nitrogen for the manufacture of the vast quantities of explosives, needed to defend and to destroy armies well entrenched, have had to find a new market. This was provided by the large area of land impoverished by the over-cropping of the war period. A demand was created by the low price at which the mass-produced unit of nitrogen could be put on the market and by the reliability of the product. Phosphates and potash fell into line. Ingenious mixtures of artificial manures, containing everything supposed to be needed by the various crops, could be purchased all over the world. Sales increased rapidly; the majority of farmers and market gardeners soon based their

manurial programme on the cheapest forms of nitrogen, phosphorus, and potash or on the cheapest mixtures.

The Use of Chemicals Has Been Increasing

During the last twenty years the progress of the artificial manure industry has been phenomenal; the age of the manure bag has arrived; the Liebig tradition returned in full force.

The testing of artificial manures and new varieties has necessitated innumerable field experiments, the published results of which are bewildering in their volume, their diversity, and often in the conclusions to be drawn from them. By a judicious selection of this material, it is possible to prove or disprove anything or everything. Something was obviously needed to regulate the torrent of field results and to ensure a greater measure of reliability. This was attempted by the help of mathematics. The technique was overhauled; the field plots were "replicated" and "randomized"; the figures were subjected to a rigid statistical scrutiny. Only those results which are fortunate enough to secure what has been described as the fastidious approval of the higher mathematics are now accepted.

There is an obvious weakness in the technique of these field experiments which must be mentioned. Small plots and farms are very different things. It is impossible to manage a small plot as a self-contained unit in the same way as a good farm is conducted. The essential relation between livestock and the land is lost; there are no means of maintaining the fertility of the soil by suitable rotations as is the rule in good farming. The plot and the farm are obviously out of relation; the plot does not even represent the field in which it occurs. A collection of field plots cannot represent the agricultural problem they set out to investigate. It follows that any findings based on the behaviour of these small fragments of artificially manured land are unlikely to apply to agriculture. What possible advantage therefore can be obtained by the application of the higher mathematics to a technique which is so fundamentally unsound?

Side by side with the intrusion of mathematics into agriculture, another branch of the subject has grown up—economics. The need for reducing expenditure so that farming could yield a profit has brought every operation, including manuring and the treatment of disease, under examination in order to ascertain the cost and what profit, if any, results. Costings are everywhere the rule; the value of any experiment and innovation is largely determined by the amount of profit which can be wrung from Mother earth. The output of the farm and of the factory have been looked at from the same standpoint—dividends. Agriculture joined the ranks of industry.

The Importance of Agricultural Research Is Great

Agricultural science, like Topsy, has indeed grown. In little more than forty years a vast system of research institutes, experimental farms, and district organizations (for bringing the results of research to the farming community) has been created all over the world. As this research structure has grown up in piecemeal fashion as a result of the work of the pioneers, it will be interesting to examine it and to ascertain whether or not direction has been maintained. Has the present organization any virtue in itself or does it merely crystallize the stages reached in the scientific exploration of a vast biological complex? If it is useful it will be justified by results; if its value is merely historical, its reform can only be a question of time.

"Mineralized Peat"

Here is a photograph of mountains of "mineralized peat" in southwestern Texas. Although these deposits are quite low in nitrogen, phosphorus and potash, they contain 20 to 40 per cent organic matter and are of low pH value.

There are deposits of rock of possible value as fertilizer all over the country. "Prospectors" will find it valuable to be on the lookout for them.

R. H. ELLIOT

The originator of the Clifton Park system of farming.

By E. F. WATSON

IT IS just fifty years since Elliot first published the book now known under the title *The Clifton Park System of Farming,* (published by Faber and Faber, London, Eng.), yet his work remains today a first-rate handbook for the good farmer.

Elliot was in no hurry to put his views on paper. For thirty years he worked as a planter in India and afterwards in England as a farmer of what was universally regarded as worn-out and practically valueless land. He thus had ample time to try out his views himself before recommending them to others.

From his fifteen years experience as a coffee planter he had learned the paramount importance of humus in the soil. He had seen magnificent plantations on virgin soil gradually deteriorate as the stores of humus in it were used up, with the onset of disease in the weakened crop, and had remedied it with top dressing of fresh virgin soil from the jungle.

He had not the knowledge we now have of the extraordinary complexity and abundance of the microscopic life of the soil and he therefore deals only with the material—humus—which enables such life to exist. His way of getting an adequate supply of humus into the land cheaply cannot be bettered today. He had immense opposition to contend with in getting his views and practice known, not only because of the innate conservatism of the farming community, but also because of the hostility of those who should have been the first to help, the Agricultural Department and agricultural colleges of Great Britain. He often compares them unfavourably with their opposite numbers in the U.S.A. at the same period. He particularly admired the way the U.S.A. subsidised experimental farms where anything new could be tried out over a long period of years instead of being left to the individual farmer. The British Board of Agriculture used to respond to his enquiries by referring him to the agricultural colleges and they in their turn merely handed out recommendations for the artificial manures that should be used.

In his frustration he declares that no one should be allowed to call himself an agricultural chemist until he has had ten years of practical experience in farming. For the college part of the training of a practical farmer he considered that a few months would suffice any man of average intelligence, provided it came after and not before the practical experience.

Elliot's method was a rotation in which the first four years were spent in building up a thick sod under grass. This was then plowed in and followed by four years cropping under roots and cereals, when the process was repeated.

But the grass had to be most carefully grown with a wide mixture of selected heavy yielding varieties combined with an adequate proportion of deep rooting plants to break up the subsoil and tap it for its contained minerals, together with some leguminous plants to add nitrogen from the air in their nodule formation. Provided this was done properly a thick sod was formed which yielded sufficient humus for all the needs of the succeeding crops without the use of any artificials.

But he points out that the real secret of success is good farming throughout. The grass must never be allowed to get away enough to become wiry, or grazed before it is well rooted or has recovered from a previous hay crop. He also pointed out that there is no cheaper way of spreading manure over the land than grazing and that close grazing is essential before the crop is plowed in, so that the urine and dung of the grazing animals may make the process one of sheet composting.

He maintained that the physical properties of the soil were far more important than its contents by mere chemical analysis, and that there is seldom any lack of essential chemi-

cals if deep rooted plants are included in the rotation to comb the subsoil for them, and he instances the agricultural practices of the East which have enabled crops to be obtained from the same soil for centuries without the replacement of the elements removed in the grain. In South India this was done by sowing a fifth line of a deep rooting bean after every four lines of the cereal crop. In North India it is more usual to have a deep rooting crop, such as pigeon pea, which reaches a height of eight feet or more in a season, every fifth year. This crop is particularly valuable through its habit of shedding its leaves, nearly all of which are incorporated in the surface soil by the earthworms before reaping time.

In good farming so much of every crop is eventually returned to the land that shortages of essential soil elements are unlikely to develop before natural processes of denudation remedy them.

It is a curious fact that the carrying out and extension of Elliot's work in a distant land under far different conditions was primarily due to the generosity of a large hearted American citizen, the late Mr. Phipps. Phipps wished to repay the hospitality extended to him by Lord Curzon and the Indian people, but being a hard headed business man he was not taken in by the clamour of the vocal minority, the politicians. They, he realised, were out to get a larger share of the loaves and fishes for themselves and had little concern for India's toiling masses, particularly the humble *ryot* of the fields. Phipps therefore gave Lord Curzon £20,000 to found an Agricultural Research Institute, the first of its kind in India, which would benefit the cultivators.

This was set up under Mr. Phipp's name by Lord Curzon at Pusa in the Gangetic plains of India. It soon grew into an all India undertaking and the first Economic Botanist to be appointed to the new Institute was the man to whom the whole world owes so much, the late Sir Albert Howard, whose unceasing efforts to reform agricultural practice and return to nature's methods, which the chemist had so largely overlooked, are a guide to all who care for the land.

Howard soon saw that the defects of Indian agriculture were due to the same cause that Elliot had found led to his Scotch farm becoming worn out, lack of humus in the soil. But Elliot's remedy of long term leys was impracticable in the plains of North India with their intense extremes of climate. No sod, as it is understood in temperate zones, is formed there. The intense heat kills most of the grass and the period of hot humidity that follows rapidly destroys any accumulation of vegetable debris on the surface. Howard showed that there you must get your humus either by a separate process of manufacture such as his well known Indore method or by green manuring or by a system of sheet composting.

Green manuring is particularly well adapted to Indian conditions, where you can grow an eight foot high crop in three months of the monsoon period. Howard explained the reasons for the many failures that had resulted from the practice of sheet composting up till then. To get the benefit of it for a succeeding cold weather crop two months later it must be treated as compost material, never turned in green and on no account buried deeply. If fermented first and then just skimmed in, as by the Indian plough which only scratches the surface, marvellous results are obtained.

Elliot stresses the importance of grass pastures in preventing deficiencies in the surface soil and the necessity therefore of limiting the area under cereals compared with that under grass, and foretold troubles that would develop if the opposite practice was followed—as has unhappily been the case in Great Britain under wartime necessity.

Elliot's seed mixtures were much more diverse than we with the improved strains now available would think necessary. Points to be noted about such a mixture are that the vigorous tall growing grasses on whose extensive root system we are to rely for humus formation when the sod is ploughed in must be in sufficient quantity to cover the ground adequately. If cramped they grow as tussocky hummocks.

Sufficient of the smaller grasses must be sown to cover quickly the spaces between the taller sorts while the latter are growing and leave no areas where unwanted weeds can develop. So important did Elliot consider this that he always went over the fields when the grass had come up and re-seeded any bare patches however small.

Of the legumes in his mixture he relied on the kidney vetch to give an early return, though it was apt to die out after the first cutting, and on the late flowering red clover to carry on during the last years of the four year ley. The deep rooters he considered had a tremendous physical effect on the land, breaking up any impervious pans below the surface and thus allowing the soil to drain quickly after heavy rain. Of these he considered chicory, whose roots would extend down over four feet into the subsoil, the most important. It is relished by stock, particularly sheep. Its use has, however, not been very general since Elliot's time owing to the poor keeping qualities of hay that contains a large proportion of it. This can nevertheless be easily remedied as Elliot showed by late grazing of the fields containing it before shutting them up for hay. The chicory, being at that time the main fodder crop, gets eaten down to the roots and never becomes rampant in the subsequent hay crop.

Burnet has also the capacity to penetrate hard pans in a manner only slightly less efficient than chicory. It grows throughout the winter and thus affords one of the earliest of feeds relished by all stock. In the hay stack it improves the quality of the hay and never crumbles to dust.

In Elliot's view there was of course no finality in seed mixtures, all of which need adapting to various types of soil. Keen observation, particu-

R. H. Elliot

Continued

larly in other countries, would probably show many types of forage plants that the experimental farms should try out. His book contains useful tables of the estimated productivity of the various types of grasses and of the number of seeds of each sort in a given weight.

In his system all deep cultivation was efficiently done by the decaying roots of his deep rooting plants, by far the cheapest method. He seems rather to have overlooked the role of the earthworm in this respect, though his method of always having ample humus in the top soil and never using the artificials they abominate, must have resulted in immense numbers of them always being at work in his land.

Elliot's work on the comparative value of the various grasses was immensely valuable. It has led since his time to the setting up of many testing stations for this purpose. The U.S.A. is particularly well provided with these stations and they are working on a much greater variety of plants than were available in Elliot's day. There is, however, the danger that some of them may recommend certain strains too exclusively. Elliot was very insistent on the necessity of growing a very wide mixture if one was to get adequate coverage to keep down unwanted sorts and maintain a pasture that would last out the full four years.

He stresses the importance of always following up the ploughing of a pasture with a green crop before putting down to cereals. Only thus can the countless seeds dormant in the soil be started into growth and destroyed without competing with the cereal crop subsequently.

The great effect of the Clifton Park system in improving the land has led to one difficulty among farmers who have been accustomed to using artificials. Too often they felt they might get the best results by using both, and needless to say any improvements in yield obtained by the farmer have been claimed by the makers of artificials as due to the use of their products. The real workers, the microscopic fungi and bacteria that the humus supports, need more publicity.

Elliot was no bigot and gave the combined system a trial, but could find no advantage whatever from the use of artificials once the land had been got into a good condition. Sir Albert Howard used to say that the chief use of artificials was to tell the farmer or gardener when he had his soil into first class condition. If any benefit resulted from their use it showed that he had not yet done so.

Mineral deficiencies in the surface soil are practically unknown where deep rooting plants are included in the rotation. They are a bogey that should be left to haunt those spots where desert conditions have endured for generations or where long continued bad farming practice has led to incipient desert conditions. It is not always realised how quickly certain plants can extend their roots. Sir Albert Howard showed at Pusa that some small fruit trees produced sixteen feet of fresh roots each year, these following the water table down as it fell to this extent each dry season. In searching for new deep rooted fodder plants particular attention should therefore be given to drought resisting capacity.

Only a long term experiment would show what benefits, if any, were due to the use of artificials only. Such an experiment is now under way at Haughley in Suffolk, England, and it is to be hoped that many more will be started in the U.S.A.

The growing and plowing under of legumes is one of the best ways to get nitrogen. Turn to page 31 for the story of one of the originators of the leguming concept.

The Contest Winners

Here are the best entries in our "How I Practice the Organic Method" Contest

First Award — $50

MY METHOD of organic farming will no doubt be quite different from that practiced on the average mid-western or eastern farm, since I use it on a California irrigated lemon grove, and crop rotation can not be used.

Prior to starting the organic method about three years ago the grove was in below average condition. The soil had a decided plow-sole and water penetration was very poor.

The first step in carrying out the organic system was the installation of a portable low head sprinkling system so that good irrigation practices could be carried out in spite of the heavy mulch that was to be applied later. It is almost impossible to use a heavy mulch with furrow irrigation. The next step was to level the ground and apply a ton per acre of Milorganite. This was followed the next spring with a rather heavy covering of chicken manure, and this in turn has been covered with a 4 inch layer of mulch-material consisting of any weed-seed-free material that could be secured at a reasonable price. Most of it is horse manure and shavings from some of several riding stables in this area, but I also used some spoiled alfalfa hay, street sweepings from a nearby city and several truck loads of turkey feathers that were available, free for the hauling, during the holiday season. I am now in the process of applying another coating of chicken manure to be covered by another mulch.

I am also raising red earthworms and have been liberating them in the grove as they are available. I use four 4 by 8 foot boxes 2 feet deep to raise the worms in. I find rabbit manure mixed with any mulching material very satisfactory for the worm culture boxes. The worms that have been placed in the grove are multiplying and are busy composting the chicken manure and mulch, changing it into the best of all plant foods. They are also breaking up the plow-sole and water penetration is now excellent.

Production has improved from an average of a little under 400 field boxes per acre prior to using the organic system to an estimated 600 boxes per acre this year of superior quality fruit.

The mulch in Mr. Lesle's lemon grove.

Weed growth at the start of the program was controlled by spraying with a weed oil, but since the mulches have been applied I have very little weed trouble and the ground has not been cultivated since the start of the program.

The operating cost has been less since using the organic system, as no tractor work is required, thereby doing away with a lot of high priced machinery that only served to pack the soil in the first place.

This system could be used for nearly every orchard and would surely prevent a great deal of harmful erosion in orchards located on rather steep hillsides.

ALBERT E. LESLE
Whittier, California

Second Award — $25

BACK IN 1937 I purchased a 78 acre farm (60 acres tillable) which I still own and operate. At that time the soil was so poor that I could not find one earthworm in all my spring plowing, which was approximately 35 acres. I planted 16½ acres of corn and harvested only four loads. In 1947, 10 years later, I planted 12½ acres of the same ground in corn and filled a 10 by 40 foot silo in addition to husking 30 loads.

My experience has always taught me to build up land the organic way. While it may mean harder work, it pays in the long run. This ground is of a slate shale and was so run down when I came that no

one wanted to rent it, much less buy it. It was natural for people to shake their heads and laugh when I bought it. This being one of the poorest farms in this section, the thought which was uppermost in everyone's mind was that I would starve to death. However, I am now glad to relate that I can raise crops as well or better than anyone else for miles around.

My wheat gets as high as an 11 by 40 tractor tire and I have seen the time when I could take a one-half swath with a combine and choke up at that. My wife and I do all the work. In addition to a herd of thirty pure bred Holstein cows we have about 300 chickens and 100 turkeys. We get plenty of manure from all this livestock.

I raise plenty of feed for my cows year after year. I have a Case baler and use three of these large bales of straw every day for bedding and always have some left over from one year to the next. I never sell any hay or straw as I want it returned to the soil along with the manure.

One of my neighbors burns or sells a lot of his straw with the result that his cattle have little bedding and his soil suffers. He says that I plant my crops too thick, but I can raise more on one of my acres than he can on two or two and a half—and on every crop that I grow.

RAYMOND KOCH
Bangor, Pennsylvania

Second Award — $25

"BEANS OR cabbage 1¢ a pound." Remember those ads in the good old days—some folks refer to them as Hoover days. It's true that when green groceries sold at such ridiculously low prices the grower couldn't make any money. Enroute to market I passed a neighbor who was also growing vegetables and had the advantage of using irrigation in his operations. Despite this extra help he turned a losing business proposition into a paying one by hauling surplus vegetables from town to the farm which he fed to hogs.

To overcome the pride of being a producer and submit to the humility of being a scavenger took quite some time, but I finally followed suit. I bought two gilts—neither I nor the seller knew that they had been bred, so by the New Year I had 15. It did not take long to see that my farm was gaining by this reversal of operations. What the pigs didn't eat was still adding something to the soil instead of taking it off. The operation meant the addition of many elements to the soil that hadn't been there as the vegetables, fruits and meat that were fed to the hogs came from practically all parts of the U.S. and some even from South America.

In many instances they were getting the most valuable part of the vegetables and fruits (peelings and outside leaves). Their diet seemed to meet their needs better than ours does us humans, for I can't ever remember a pig having a toothache! Folks that sell salt highly recommended adding a mineral supplement to pigs on feed. I tried it, but they never made use of it. The pens were built of slabs and moved to keep the pigs on clean ground; where they had been the sand became land strong enough to grow lush Bermuda grass. Litters coming during cold nights led me to gather leaves and lawn trimmings from the parkways in town for bedding.

After so many years of this the good news from *Pay Dirt* was told me by a friend and operations were enlarged to include the making of compost by the Indore process. This is where banana stalks, spanish moss, packing hay and straw, coffee grounds and tea leaves from a chain restaurant and finally sawdust were included in the gatherings. The crating, cardboard and paper were used as fuel to cook the hog feed and the ashes put in the compost pile as a source of potash and lime. From time to time the cooked bones were gathered and ground in a large hammer mill and the meal added to the compost. So the pigs led the way to happier days from the profit standpoint. They make good bulldozers for clearing raw land.

On some of the low ground, limerock and ground phosphate were added to condition it for a seeding of Kansas alfalfa. This land gave three good cuttings of hay the following winter. It didn't need any introduction to the 10 head of cattle on feed and made a good supplement to silage and sugar cane.

The following year another patch of alfalfa was seeded, as the first didn't survive the summer rainy season here. This time we only saved three cuttings, rain spoiled the fourth and it was added to the compost pile to give it oomph.

Next year, white dutch clover was planted which would yield a forage the animals could harvest themselves and which re-seeded itself nicely. For hay a patch of rust proof oats was grown which yielded a good crop and seemed to be well relished by the stock.

So now where once we struggled to grow vegetables and corn, cows are grazing and making manure, some of which is used as a mulch to improve the soil in our fine orange grove. Each spring we plan and plant hoping to arrive at a balanced agriculture for this spot on God's good earth. I once read of a scientist who remarked that "anything will give up its secret if you love it long enough."

JOHN E. VOLKERT
Orlando, Florida

The following each received a Third Award of $10 for their entries: T. L. Ackerman, Ticonderoga, N. Y.; Walter Brown, Larue, Arkansas and Amos L. Keener, Lititz, Pa.

Miscellany

Water costs are high, so hold on to the rain that comes your way.

PROFESSOR Paul D. Sears, a noted conservationist, who is to teach that subject at Yale this fall, recently said that destructive land practices are costing farmers as much as their taxes in some instances. He spoke at a meeting of the Western Reserve Chapter of Friends of the Land. He said, "We have learned that 12 per cent of the farmers of Lorain County (Ohio) are buying water from one dealer. We know that many more are forced to buy water in order to continue farming. Four thousand tons of water fall on each acre annually in the form of rain. Enough of that for all their needs could be held in the soil if the men farmed properly. It would mean they would have to change their operations from soybean and corn raising generally to more permanent pasture."

On our farm here in the Lehigh Valley of Pennsylvania, we took a soil terribly hardened by the long use of chemical fertilizers, whose rain waters would come rushing off the land like a Niagara, and in a few years of using only organic matter as a fertilizer, have so softened its structure that it now drinks in every bit of rain. Come and see our farm this year. It is located between Allentown and Emmaus, Pa.

At the end of the meeting, in answer to the question "Can the world be fed through other means than products of the soil?" Professor Sears answered, "When the time comes that I have to eat diatoms and yeast in preference to good beef, then I don't want to go on."

The Handwriting

There are many symptoms that things are not right in agriculture. Water shortages all over the country are one of them, and an extremely important one it is. The Dust bowl is another and it is enlarging its area more and more each year. Thirdly, there is a lowering of human health, an alarming increase in cancer and heart disease. Much of this is caused by the devitalized food produced by the use of chemical fertilizers, insecticides and hybrids.

In recent tests it has been shown that many hybrid corns lack six or seven trace mineral elements which are contained in the open-pollinated varieties. Also, the protein content of grains is going down. In the Middle West in a recent ten year period the protein content of grains went down 10%, which means that the carbohydrate content went up. It is known that the overuse of potash causes an increase in the carbohydrate content of many food crops and medical research has shown the danger of too much carbohydrate. Unbalanced plants attract insects.

Here is a fourth and alarming symptom. The 1950 migratory bird

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MISCELLANY

Continued

census shows a drop of almost 25% from the 1949 count of North American waterfowl—geese, ducks, coot, swans and brant. The director of the U. S. Fish and Wildlife Service claimed that the decline was due to a late breeding season in the previous year combined with droughts and excessive drainage of waterfowl havens in the prairie sections of the country. That may be so, but I am sure he is overlooking the killing out of much of our wildlife by the spraying of DDT and other poisonous sprays by airplane and by ground equipment. The Audubon Society has often discussed this aspect in their utterances and in their publications.

I am giving herewith an item published in the *Chicago Journal of Commerce* (Apr. 24, 1950) which discusses the toxicity of the newer and more poisonous insecticides. It indicates that there is great danger to waterfowl if they drink standing water into which some of these poisons drain. Here is the item:

Washington, April 23—Some soils and some crops are less readily poisoned by accumulated insecticides, Agriculture Department experts agreed.

But the experts of two bureaus split over how serious these effects are. Reseachers in the Bureau of of Plant Industry disclosed last week that DDT and benzene hexachloride tend to poison soils into uselessness after a period of concentrated use.

This view has been disputed in part by the Bureau of Entomology and Plant Quarantine, which contends the effects are not really serious enough to warrant severe reductions in farm use of the two bug killers.

The division of opinion appears to stem from the two bureaus' respective interests in preserving soils and killing harmful insects.

Set Up Study Group

A panel representing bureaus involved has been established to study the toxic effects of insecticides. B. R. Boswell, of the Bureau of Plant Industry, is chairman.

Soil specialists say sandy soils may show toxic results which retard growth in one season, while muck soils will absorb much more of the insecticides before crop damage is noted.

BEPQ experts believe tests are not conclusive enough. They point out that farmers are using the insecticides with better judgment than when the "miracle" products were introduced a few years ago.

Urge Use of Purer Forms

Plant industry investigators recommended use of the purer forms of DDT and the gamma isomer of benzene hexachloride to reduce soil contamination. They said tests on grains show alpha, beta and delta isomers of benzene hexachloride, not as insecticidal as the gamma isomer, are more injurious to growth. These isomers also are responsible for most of the offtaste attributed to benzene hexachloride. The BEPG now is advising against use of benzene hexachloride on cotton if potatoes are being planted as an alternate crop.

Tests on orchard cover crops as well as grains show differences in effects of soil toxicity among crops and varieties.

Orchard tests show growth of cover crops may be greatly retarded by normal insecticide spraying over several seasons, Growth and production of established trees is unaffected, the experts said, although young seedlings do not grow readily in affected soil.

Organic Matter

Here is a letter written to me by a bureau of the U. S. Department of Agriculture. It came to me in answer to a letter I sent to the Department of the Army in Washington concerning the practice of subsoiling to reduce the amount of floods:

Dear Mr. Rodale:

Your letter to the Department of the Army concerning the practice of subsoiling to reduce the amount of floods has been referred to the Soil Conservation Service for reply.

The Department of Agriculture has been directed by the Congress. in the Flood Control Act of 1936 as amended and supplemented, to make investigations of watersheds for the purpose of developing recommendations for watershed treatment for runoff and waterflow retardation and soil erosion prevention in the aid of flood control. In making these investigations the Department of Agriculture attempts to consider all phases of land use, practices, and treatment which affect the infiltration of water into the soil, together with the effect of surface flow on flood damages. Such practices as crop rotation, cover crops, contour tillage, strip cropping, terracing, contour furrows and ridges,

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basin listing, subsoiling, and other measures which favor infiltration of precipitation are all studied for the effect which they have in reducing runoff and preventing erosion.

If there is anything further that you would like in this connection, please let us have your further request.

I give this correspondence to show that the U. S. Department of Agriculture is not fully aware of the tremendous value of organic matter in preventing floods. The letter above mentions cover cropping, which is an excellent practice, but which is not sufficient to build up the organic matter content of a soil. There is a crying need for the utilization of organic wastes such as corn cobs, sawdust, garbage sludge, leaves and hundreds of other items which are now burned, dumped or destroyed in some manner. If some extra, outside organic matter, was procured for use on every farm, and we know there is a sufficiency for all, it would not only act to loosen up the soil so that it could drink up all the rain, but it would cause an increase in crop yields. I note also that the letter above quoted said nothing about manures.

will not be forced to share moisture.

Organic farming is made up of day to day jobs such as this more often than it is something special. It is not rich man's farming as some claim, although the man of means who operates a farm will usually be an organic farmer. But it is or should be especially poor man's farming for the man who wants to progress beyond hand to mouth farming and obtain the greatest results from the least work and acreage.

We had an elderly neighbor some few years ago whose farming practices put him out of business within fifteen years. He had a herd of milch cows and several hundred chickens when I first knew him, but his soil became more and more depleted as he farmed everything out of it and put nothing back. Yes, he put back the manure, but it was poor to start with because the feed was poor and would be refused by cows used to good hay, and the manure was left out in the weather.

I have seen farms go down and I've seen them increase in fertility, and according to my observations the farm family goes down or up with the land.

Let Organic Farming Prove Itself

(*Continued from page* 30)

never had a good picking from the field because the quack grass took moisture sorely needed by the plants.

However, we feel that the results were worth the cost, for the quack has been completely killed out. The asparagus plants made a greater growth from the middle of June, when harrowing was discontinued, to late October than ever before. Further, tons of quack spears and roots were broken up and returned to the soil, which will release plant food for the 1950 crop. And the crop

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PAY DIRT is a natural for everyone who wants to adopt organiculture. Cloth, 252 pp. **$3.00**

THE HEALTHY HUNZAS

A BOOK about the inhabitants of the northwestern section of India who are astoundingly healthy because of the way they raise their food. A race of over 22,000 people, the Hunzas possess a bodily buoyancy that makes them unique among the world's national groups. Full details show how any gardener or farmer can apply the Hunza methods. Cloth, 263 pp., 20 full-page illustrations. **$3.00**

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The amazing story of an organic farm

HUMUS and the FARMER

by FRIEND SYKES

TELLS how 750 "worthless acres" were changed into rich farm land by use of the organic method. Filled with graphic descriptions, illustrations, recommendations for making pastures, reclamation of waste or derelict lands, and increasing the water-holding capacity and productivity of the soil. The value of mixed farming and reforestation, the importance of the earthworm, and the mechanization of the compost method are all clearly explained.

Friend Sykes' account begins when what was regarded as one of the best herds in England proved, upon government inspection, to be 66% diseased—the result of deficiencies in the food plants. The herd was dispersed and the valuable farm land sold. Friend Sykes then purchased 750 acres of land on the Salisbury Plain which farmers round about considered practically worthless. He subsoiled it and fertilized with natural manures exclusively. Pasture and crop plants were grown which were rich in minerals and other nutrient materials.

As a result, the cattle and horses were maintained in health and vigor that had been hitherto unknown, and the land is now visited by outstanding agriculturists as one of the most interesting farms in England. 416 pages, 40 photos. **$4.50**

***Western Land and Water Use*, Mont H. Saunderson, University of Oklahoma Press, $3.75.**

HERE is an authoritative and well written book about the physical problems of the West. It should be of interest to all Western farmers who are striving to make better use of their land and the water that falls on it.

The prevention of too rapid run-off is the goal of Mr. Saunderson's projected soil and water conservation program. He is seeking to prevent the rapid filling up of Western reservoirs with silt washed off farms and grazing land by seasonal rains and flash floods. It is easy to see why many dams will eventually be rendered useless by the accumulation of silt unless the receptiveness to water of the land where the rain falls is increased. The large and important Elephant Butte reclamation reservoir on the Rio Grande is being filled by sediment at the rate of ½ per cent of capacity every year.

Improvement of the government's advisory service to farmers, claims Mr. Saunderson, will help in this soil conservation work. "In the past," he states, "the operator and manager of the farm has had the help of the extension specialists—the agronomist, the animal husbandman and the agricultural engineer—in the constant improvement of farm production technology. He has had comparatively little help in the management planning of the farm, other than for current price and profit objectives. It now seems clear that for the farm operator's interest in the land and for society's interest in the land, the operator's greatest need is for help in management planning to conserve the soil.

"In such a design the county extension agent would become the county agricultural conservationist. Rather than being a commodity specialist, as is now often the case in the production features of the work, he would, in this role of county agricultural conservationist, be a farm-management planner working to relate the alternative production opportunities of the farm to good land use and to maintenance of the soils.

There is no doubt that many farmers need more on-the-spot help in farm management from men trained in that field. However, in our opinion the ultimate value of any help and advice given by such agents depends on the degree to which they understand the basic processes of the soil and the value of organic matter.

Technical Books

The Chronica Botanica Company of Waltham, Mass. publishes many fine technical books on botany and agriculture. Those listed below may be of interest to farmers with a scientific turn of mind:

Peat by A. P. Dachnowski-Stokes, $5.00.

Agricultural Plant Pathology by Neil E. and Russell B. Stevens, $4.00.

The Rothamstead Symposium on Trace Elements by T. Wallace and others, $4.50.

Forest Soils and Forest Growth by S. A. Wilde, $5.00.

The Actinomycetes by S. A. Waksman, $5.00.

Plants and Vitamins by W. H. Schopfer, $5.00.

The Inorganic Nutrition of Plants by D. R. Hoagland, $4.50.

PREVENTION

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Don't miss the first issue of this new monthly magazine, published under the editorship of J. I. Rodale. It is a new departure in magazine publishing. The entire issue will be devoted to ways of preventing.

POLIOMYELITIS

Infantile paralysis, which has been alarmingly on the increase, frequently attacks adults. Did you know there is evidence that diet may be a factor in its causation?

The June issue of **PREVENTION** contains ten articles by and about physicians and their polio theories, including one specially prepared by the National Foundation for Infantile Paralysis. It is typical of the hundreds of valuable hints that will appear in this unique publication, all selected and developed for their value in making our lives longer and healthier. **PREVENTION** is dedicated solely to the conservation of human health, stressing not the cure of disease but its prevention.

The new Rodale magazine will be conducted on the highest ethical and humanitarian plane. Except for organically produced food, **PREVENTION** will contain no advertising. The editors will be free to comment on products they consider worthy of mention.

How PREVENTION Started

J. I. Rodale's first interest, which was in the field of general health, has long been reflected in the pages of Organic Gardening. Thousands of subscribers have shown extreme interest in health matters, and are continually writing us for health information. As it has been impossible to do full justice to this subject in a gardening magazine, we felt we could perform the job far more thoroughly by starting a new publication, the material for which will be written by experts.

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The first issue will be out around June 15. Consider the cost not as a subscription to a magazine, but as a medical fee to enable you to keep posted on the latest discoveries in the prevention of disease, and to stay healthy. Better to pay this small fee than to pay the doctor! A year of PREVENTION is worth a decade of cure.

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Dept. OF, Emmaus, Pa.

Memos To Farmers

Penicillin in Milk Causes Trouble For Cheese Makers

Here is an item from *New Agriculture*, a California farm monthly, that should be noted by dairymen:

"Dairy farmers using penicillin, streptomycin, or similar materials in mastitis control, were advised by H. C. Hansen and J. C. Boyd of the department of dairy husbandry to withhold from their shipments of market milk the first four milkings from the treated quarter of the cow's udder.

"During the past year cheese factories and creameries making cheddar cheese and cottage cheese and buttermilk have reported a sharp increase in manufacturing difficulties, Boyd declared. Reports indicate similar difficulties are being encountered in other parts of the United States, Australia, New Zealand, and Canada.

"Last summer university cheese makers began to experience the same trouble. Some cheese vats were completely "dead." Others were slow to make and produced poor quality cheese. Running down all possible leads, the University dairymen finally discovered that the trouble came from traces of penicillin in the milk. This penicillin came from cows being treated for mastitis."

Undersea Phosphate Deposits Found

Robert H. Stewart, a government geologist, has reported the probable discovery of large phosphate-bearing deposits off the coast of Florida. Although the possibility that these deposits will be exploited commercially is "remote," Mr. Stewart reports, there is some chance that they will some day be used as raw material in our atomic energy program. Phosphate rock, it has been found, contains low concentrations of uranium and other fissionable materials.

Chemical Fertilizer Injury Increases In California

The California Experiment Station reports that damage to greenhouse gardenias from soluble salts is becoming quite a problem in that state. The salts are built up in the soil by the use of chemical fertilizers and by excessive irrigation with water from deep wells.

It is easy to understand how chemical fertilizers can cause this type of crop damage. In the case of super-phosphate, the plant food in rock phosphate is made extremely soluble by the addition of sulfuric acid. When the fertilizer is used, the phosphorus is taken up by the plant, washed out or absorbed into the soil in an unavailable form. However, the toxic elements that were used to make the phosphate rock soluble build up in the soil and cause damage.

The use of organic fertilizer will eliminate soluble salt damage—even when it is caused by using irrigation water of high saline content. Organic matter acts as a buffer in the soil, preventing damage to plants from poisonous substances that may slip into their environment.

Dairyman-Orchardist Has Slick Manure Handling Technique

Carl W. Muller, who has a dairy and orchard near Turlock, Cali-

fornia, has developed a method of moving manure automatically from his barn to a cistern where it is mixed with water and pumped right out to his fields. This way, he claims, none of the manure's value is lost and there is a considerable saving in labor. Irrigation water that is as rich in manure bacteria as is Mr. Muller's would be an excellent activator for sheet compost.

Antibiotics Being Considered As Plant Disease Cure

Plant scientists are now looking to the antibiotics, such as penicillin and streptomycin, for aid in controlling plant disease. The Canadian National Research Council and the Dominion Department of Agriculture recently took part in a discussion on antibiotics and plant disease at Winnipeg, Canada.

It was pointed out that "chemical sprays now in use are expensive and frequently cause harm to the treated plant. Antibiotics, however, have a selective action and prevent disease without damage to the plant."

It is indeed pleasant to note that some scientists are leaning away from caustic sprays and are trying to find more satisfactory substitutes for them. Let's hope that the antibiotics won't kill the necessary soil bacteria along with the harmful organisms.

A Field Chopper Can Be Used For Sheet Composting

If you are so unfortunate as to have a cutting of hay spoiled by rain you can make the best of the situation by driving down the windrows with a field chopper. The spoiled hay will then be scattered back on the land with comparatively little labor and will not interfere with the growth of the next cutting.

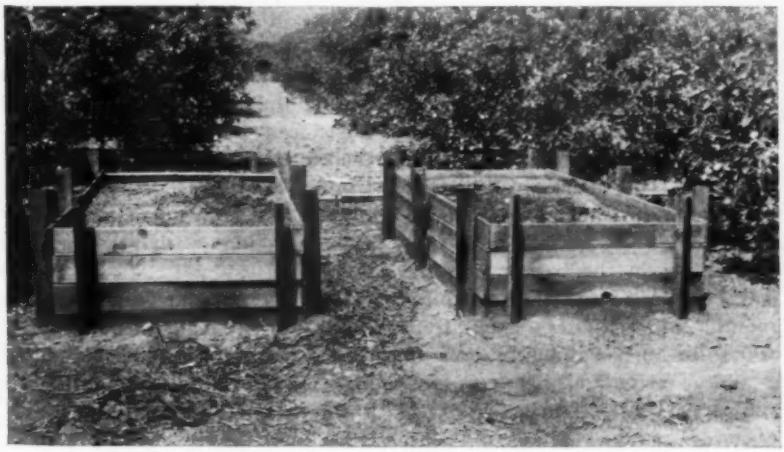
The Newest Pesticides Are Really Dangerous

A farmer who doesn't use the newer insecticides parathion and TEP is really taking out life insurance in his own name. Here is one description, from the Wisconsin Agriculturist, of the symptoms of parathion and TEP poisoning:

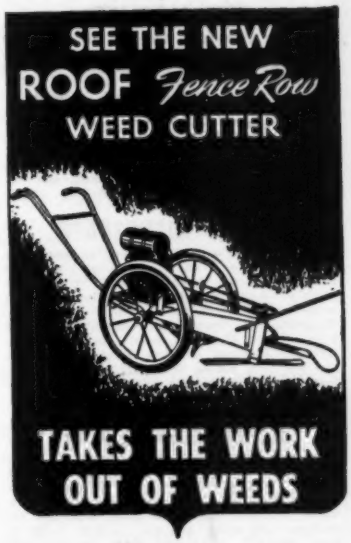
"The symptoms of poisoning include headache, usually accompanied by blurring of vision and dizziness. This is followed by weakness, nausea and vomiting, cramps in the stomach, diarrhea, a feeling of discomfort in the chest and eventually a twitching of the body muscles."

These symptoms can be caused by contact of the spray with the skin or by the inhalation of its fumes.

R. R.



These outdoor boxes are used by Mr. Albert E. Lesle—winner of our "How I Practice the Organic Method" contest—to raise earthworms which are liberated in his grove. Cultured earthworms are also extremely valuable as feed for chickens.



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Livestock

Don't Feed Coal To Your Pigs

The belief that feeding coal to pigs is a good practice is held by some farmers. However, experiments at the University of Wisconsin has shown that pigs that crunch coal gain less per pound of feed and have no immunity to roundworms or necrotic enteritis, as was commonly believed.

It was found in the tests that soft coal in particular reduced thriftiness when a fifth to a quarter pound a day was fed.

The most important aspect of tests like these should be the determining of the effect of feeding practices on the health of the pigs and the food value of their meat—rather than on the fact that one practice or another made them gain or lose weight. Both the livestock man and the experiment stations should realize that the consumer has a right to expect a top quality product.

Help Cows Have Sound Feet

"My feet are killing me" is a familiar phrase in cow language, too. Sore feet have sent many a good cow to the butcher's at too early an age.

Spring is the time to examine the feet of the dairy stock and do some hoof trimming wherever needed.

Standing in the barn or on the soft bedding of a loafing shed for months often causes "long feet" which in turn frequently lead to trouble. Trimming helps to prevent foot rot, and makes walking easier. The cracking of the skin around the hoof is lessened and harmful bacteria cannot enter easily.

The only tools needed can be obtained at a good hardware store. They are hoof nippers, chisel, rasp and knife—preferably a hoof knife. Trim the outer edge of hoof with nippers, starting at the rear and working forward. Carefully clean out the sole, making it a little hollow so the weight of the animal will be on the outer edge of the hoof. Avoid cutting into the "quick." To prevent splitting, rasp down the sharp edges.

Much Lightning Damage Can Be Prevented

Many a farm animal can be saved from destruction by lightning with just a few simple precautions. The toll of animals standing near fences can be reduced, for example, simply by grounding the fence at about 200-foot intervals.

The way to do this is to place a Number 12 wire 3 or 4 feet into the ground at a post and run it along the post to the top, cross-stapling firmly to all intersecting fence wires.

During spring, when the ground is soft, the wire usually can be forced down to the required depth. Or a hammer can be used on a clamp. In hard or dry soil a soil auger can be used and the wire placed into the hole and tamped firmly. Simple yet effective lightning arresters are available for use in connection with electric line fences.

Animals standing under a tree can be protected by putting a lightning rod up the tree trunk to the highest point and grounding it down to where the soil is permanently moist. Trees in the pasture lot offer shade and improve the looks of the farm, but they are definitely a lightning hazard. Such trees often can be saved by protecting them with lightning rods.

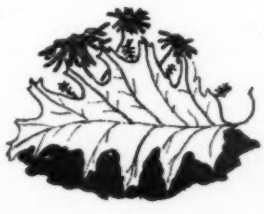
Windbreaks

(*Continued from page 28*)

eysuckle, Eastern and Rocky Mountain red cedar, and ponderosa pine. In the dry-farming areas of Washington, Idaho and Oregon green ash, black and honey locusts, Chinese elm, boxelder and ponderosa pine are successfully grown. Golden willow, silver poplar and native cottonwoods also thrive in the same region where there is sufficient moisture. Suitable trees for Corn Belt windbreaks include the green ash, American elm, black and honey locusts, hardy catalpa, black walnut, Russian olive, redbud, honeysuckle, Norway spruce, white and Black Hills spruce and red and white pines. The green and golden willows and native cottonwoods also do well in moister areas. Conifers are generally favored in New England and the East Central states. From Georgia westward to Eastern Texas, wherever sandy soil threatens to erode, the native pines, particularly the loblolly, are good both for windbreaks and soil control.

Regular farm equipment can usually be used in cultivating the trees in a windbreak. If they are spaced twelve feet apart, cultivation is usually necessary for five years. With closer spacing, grass is shaded out more quickly, and three years may be enough, unless there has been little rainfall. After that, except for occasional thinning and the removal of broken branches, a windbreak is on its own.

It certainly pays its way, making the farm more congenial for crops, livestock, and human beings. And in case a farm is one day sold, the shelterbelt that has contributed its share toward increasing income will also result in a higher selling price for the farm.



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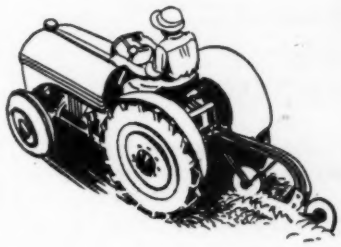
B. C. A. can be used with great success in the New Sheet Mulch Method of Fertilizing. Applied directly to the soil mixed with raw organic matter, B. C. A. will speed up the break-down of the mixed wastes.



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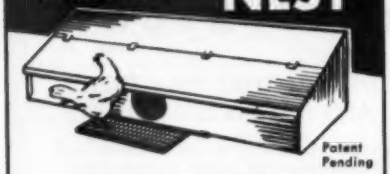

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Poultry

Feeding Charcoal to Chickens Is Not Recommended

You will get no benefits and may actually hinder the growth and development of your chicks if you include charcoal in their rations.

Sam Ridlen, extension poultryman at the Illinois College of Agriculture, says that farmers frequently ask him whether charcoal will improve the health and reduce the death rate of their chickens.

Some experiments were made at the University of California several years ago, Ridlen says, to find out what happened when charcoal was added to chick rations. The tests were made because claims were being made that charcoal removed from the digestive tracts of the chickens such things as carbon dioxide, ammonia, bacteria, pigments, poisons, and enzymes.

Results of the tests showed that when charcoal was added to the chicks' diets their growth was not too good, 15 out of 20 chicks in the lot had vitamin A deficiency, blood-clotting time was increased to more than 30 minutes because of lack of vitamin K, and all of the chicks had eroded gizzard linings. There was also some "curled-toe paralysis," a sign of lack of vitamin G.

In the lot of 20 chicks fed the same diet but without charcoal, growth was good, there were no cases of vitamin A deficiency, blood-clotting time was only 2.4 minutes, and all gizzard linings were normal.

To Save Turkey Eggs

Poultry raisers are frequently perplexed by the problem of preventing egg breakage. Particularly when nests are located on concrete floors, desirable from a sanitation standpoint, egg losses can easily skim the profit from an otherwise efficient operation. F. R. Huntsinger, California turkey rancher, solves the difficulty very adequately by using a base of tough, durable tobacco stems for his nests. The stems are sufficiently resilient to provide a cushion on which the eggs are cradled rather than crushed. They will not pack as will straw and other materials. Over a couple of inches of tobacco stems, lay about two inches of fine sand in which the hens can nest. Eggs can then be gathered whole and clean.

NITROGEN

(*Continued from page 24*)

teria may fix as much as 40 lbs. of nitrogen to the acre a year.

Nitrogen Fertilizers

There are many materials which contain appreciable amounts of nitrogen and may be used as valuable sources of this element. Such materials are as follows:

Hoof and horn Meal	10 to 16 %
Feathers	15.3
Dried blood	10 to 14
Felt wastes	Up to 14
Leather dust	5.5 to 12
Tankage	8 to 10
Silk mill wastes	Up to 10
Wool wastes	3.5 to 6
Cottonseed meal	7
Tung oil pomace	6
Rapeseed meal	5 to 6
Castor pomace	4 to 6.6
Peanut shells	3.6
Tea grounds	4
Tobacco stems	2.5 to 3.7
Garbage (New York City analysis)	3.4 to 3.7
Raw bone meal	3.3 to 4.1
Steamed bone meal	1.6 to 2.5
Bone black	1.5
Sugar wastes	1 to 2
Cocoa shell dust	1
Cocoa residues	2.7
Coffee grounds	Up to 2
Olive pomace	1.15
Grape pomace	1
Eggshells	1
Wet brewers grain	1

Manure

Cattle (excrement	0.29
Cattle (urine)	0.58
Hen (fresh)	1.63
Horse (urine)	1.55
Horse (excrement)	0.44
Sheep (excrement	0.55
Sheep (urine)	1.95
Stable manure (mixed)	0.50
Swine (excrement)	0.60
Swine (urine)	0.43

Marine Products

Dried Jellyfish	Up to 4.6
Fresh crabs	5
Dried ground crabs	10
Dried shrimp heads	7.8
Lobster wastes	2.9
Shrimp wastes	2.9
Mussells	1

What is guano? Is it of any value as a fertilizer?

Guano consists of the droppings, dead bodies, and other residues from bird and bat colonies in regions without rain or in caves. This material is a powerful source of nitrogen. Even though guano is a natural fertilizer, it should be used sparingly if at all because its high solubility may make it detrimental to plant health. Whenever used, it should be mixed with large quantities of organic matter.

How Soil Was Formed

(*Continued from page 8*)

such as chlorides, sodas and sulphur. They would not be dangerous if they were diffused properly as nature does in rocks. There are some rocks which may contain certain elements in too large a quantity, but then they would not be recommended for use as a ground rock fertilizer.

This "diffusion" principle, which is a valuable device used by nature, can be described by citing how a fish swims in ocean water which has all these minerals contained in rocks. It can exist safely in such waters. But should something happen to make some of the elements concentrated in one place, it would become poisonous and the fish would die. This diffusion principle is an important one in the general study of the organic method. Both in organic matter and in rocks, all the elements and compounds are safely diffused throughout the mass. This is something that man cannot do in the laboratory or the factory, however much he mixes or homogenizes matter manually. If he lets nature enter into the process, like in the making of yeast, a true diffusion can take place.

Truth About ORGANIC FARMING

AMAZING new handbook by Dirt-Farmer W. T. Jack, shows you how to get a greater yield from the soil. Here are practical and scientific reasons for making a quick return to the earth of all residues. FIND OUT how to produce better and abundant crops, the value of rotation, soil nutrients, hundreds of other items of helpful information that will serve you as a useful reference. Hurry — Order "The Furrow and Us" NOW!

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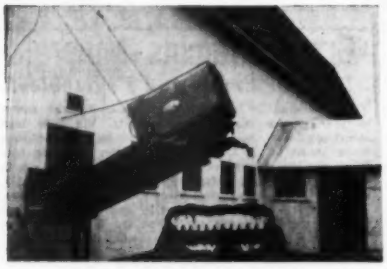
Clay Equipment Corp.

A new "job-rated" electric barn cleaner designed for the dairyman who milks a limited number of cows, will be made available by the Clay Equipment Corporation this year. Besides saving time and money, the Clay cleaner will assure you of more potent manure since more of the vital soil building liquid manure is saved than is the case with hand shoveling. All liquids are swept directly to the spreader and none are lost on the litter alley.



The Clay cleaner will feature a lighter-weight chain and smaller motor than the heavy duty model (pictured above) produced by this corporation. The new model is a continuous chain, single motor, pitless type. Full details are available. CLAY EQUIPMENT CORPORATION, Cedar Falls, Iowa.

Home Simplex Soil Tester

The Edwards Laboratory

An efficient, practical and accurate soil tester for the home gardener is now being offered by The Edwards Laboratory. It has been named the Home SIMPLEX Soil Tester and can be a valuable aid in producing more nutritious fruits and vegetables, finer flowers, healthier shrubs and greener lawns. The SIMPLEX is quick as there is no waiting for solutions to clear. Every kit contains filter equipment.

No knowledge of chemistry is necessary and droppers are provided to facilitate testing, to make the tests easier to perform and to prevent spilling. This method of testing is based on the Spurway method recently developed at Michigan State College by Dr. Charles H. Spurway. It has provided exceptional results for commercial growers.

The Home SIMPLEX Soil Tester will make a total of 80 tests, 20 each for nitrogen, phosphorus, potassium and acidity plus tissue tests for nitrogen, phosphorus and potassium. It is complete with easy to follow directions and is packed in a practical metal box. Retail price is $6.50 at dealers everywhere or write: EDWARDS LABORATORY, Box 2742Y, Cleveland, Ohio.

Tractor Hitch

Walters Mfg. Company

A revolutionary Tractor Hitch has been announced by the Charles G. Walters Manufacturing Company. The Walters' "Easy Way" Tractor Hitch embodies many new and exclusive features. The self-locking feature eliminates getting on and off the tractor and any trailing implement can be coupled from any angle of approach. A handy pick up rod is included with every hitch at no extra cost. Constructed of finest steel, the small yet sturdy hitch is easily disassembled for cleaning and lubrication. It is NOT a welded hitch. There are no exposed springs to stretch, snap or come unhooked and a positive safety lock assures secure highway travel. This 10 pound hitch is designed to permit the shortest possible turning radius and will not bind pin when running over bumps or ditches.

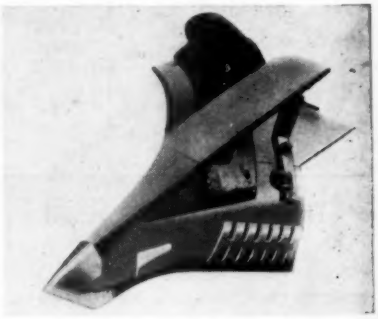
The "Easy Way" is compact and precision-built. It is designed to save the farmer time, money and labor and to help prevent accidents. It

can be used on any tractor and with all trailing implements and is fully guaranteed for one year against defective workmanship and materials. The Walters' "Easy Way" Tractor Hitch retails at $8.95 through established dealer outlets. WALTERS MANUFACTURING CO., Storm Lake, Iowa.

Plowshare Attachment

Farmers Tool & Equipment Company

A new plowshare attachment designed to eliminate sharpening and repointing plow shares is being offered by the Farmers Tool & Equipment Co. Known as the "Plowmaster" it is available to fit all popular makes and sizes of moldboard plows. No bolts or clamps are



needed for installation; the low-cost replaceable unit slips over the point and wedges over the heel of the share, securely held by spring-grip fingers. Cost of the "Plowmaster" is approximately that of re-sharpening a worn share.

The "Plowmaster" is manufactured by FARMERS TOOL & EQUIPMENT COMPANY, 4053 Harlan Street, Emeryville 8, California, and will be distributed through implement dealers.

Aqua-Queen

Woodmanse Mfg. Company

The Aqua-Queen, a new, compact, easy to install automatic water system has just been introduced by Woodmanse Mfg. Co., manufacturers of pumps since 1861. It may be plugged into any electric outlet and requires only two pipe connections to provide a completely automatic home water system.

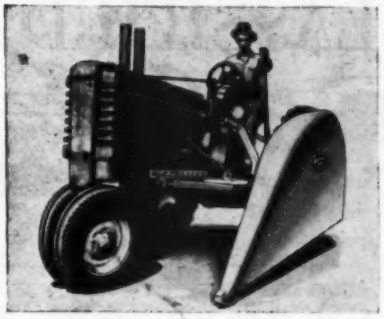
There are no exposed belts, pulleys or shafts to injure small children or household pets. The pump is installed inside the tank where operating noises are muffled and confined to assure quiet operation. The Aqua-Queen can be installed in any space 18 inches in diameter and 25 inches high. WOODMANSE MANUFACTURING CO., Freeport, Illinois.

Corn Saver Shield

Kooiker Mfg. Company

Among four new products recently announced by the Kooiker Manufacturing Company is a corn saver shield which fits over the large rear wheel of the tractor. This device saves wind damaged corn and enables picker to gather maximum number of ears by gathering a high percentage of corn that would otherwise be trampled or lost.

The long snout slides under cornstalks that are bent, twisted or tangled, straightens the stalk and directs it either into the picker or away from the path of the rear tractor wheel. The Corn-Saver-Shield sells for $47.45 plus state



sales tax. KOOIKER MFG. CO., Hull, Iowa.

Sickle Grinder

Lantz Mfg. Company

A new sickle grinder that will grind sickle bars from one to seven feet long has been developed by the Lantz Manufacturing Company.

All bars are ground with equal ease and with the same grindstone.

No skill is required and you are assured of a uniform edge and proper bevel, which extends the life of your sickle. The grinding stone is mounted in a swinging arm and grinds coming and going. A spring-loaded table keeps sickle section against the stone. The grinder is drilled for mounting on wall or bench. Available with or without electric motor or gasoline engine for field use. Descriptive folders are offered. LANTZ MANUFACTURING COMPANY, Valparaiso, Indiana.

FARMER'S BOOKLET LIBRARY

Free or inexpensive publications dealing with various phases of farming and farm life.

THE FOLLOWING practical and helpful booklets are available to farmers and are offered by the concerns listed. Except where a small charge is mentioned, they can be obtained without cost.

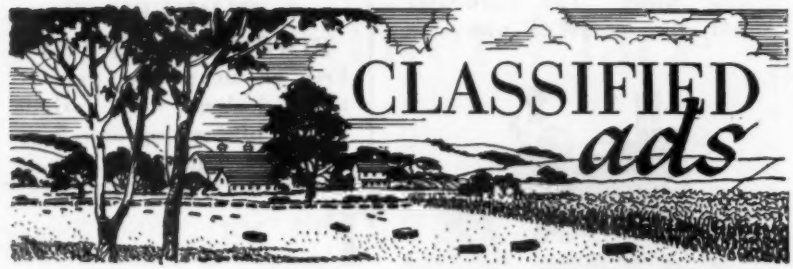
A national menace—soil washing. Our farmlands annually lose enough topsoil to make a pyramid a mile square at the base and over two miles high. WIN AGAINST WATER, complete with pictures and diagrams, tells how to stop this loss. J. I. Case Co., General Office, Racine, Wisconsin.

Proper tillage and the corn borer. Proper soil tillage and timely planting have been the most effective weapons used against the corn borer to date. BATTLE THE BORER WITH PROPER TILLAGE gives a complete account of this method of control. Allis Chalmers Mfg. Co., Tractor Division, Milwaukee 1, Wisconsin.

Primary facts about the Holstein cow. A detailed outline of the complete history of the Holstein cow is given in THE HOLSTEIN HANDBOOK, now being offered at 25 cents per copy by Holstein-Friesian Association of America, Brattleboro, Vermont.

Steel for farm buildings. Complete instructions on how to modernize farm buildings with steel are offered in PRACTICAL PLANS FOR MODERN FARM BUILDINGS. Included are blueprints and sketches for erecting any type building on the farm. Continental Steel Corp., Kokomo, Indiana.

The question of grit. Five pages of questions and answers on the use of grit make up the educational bulletin, ANSWERS TO THE GRIT QUESTION, distributed by the Stone Mountain Grit Co.. Lithonia, Ga.



FERTILIZERS—SOIL CONDITIONERS

Proper use of ROCK PHOSPHATE can make your organic farm pay handsomely. Quotations furnished on finely pulverized Tennessee rock in any quantity and Florida rock in carloads only. Free informative literature tells how. See April issue for prices.. **H. R. LEFEVER, R. 1, Spring Grove, Penna.** (at Stoverstown, York County).

CLEVELAND, OHIO AREA Gardeners. Ruhm's Phosphate Rock, small or large quantities on hand. **W. F. SCHMITT, 28660 Lorain Rd., North Olmsted, Ohio.** Phone **TR 1-2578.** District Representative.

ROCK PHOSPHATE—FLORIDA—Hi-Test finely pulverized. **DWIGHT DAVIDSON, R. D. No. 4, Wellington, Ohio.**

POULTRY MANURE: 100 lbs. in 50-lb. bags $2.00; 500 lbs. in 50-lb. bags $9.00; 1000 lbs. in 50-lb bags $16.00; 2000 lbs. in 50-lb. bags $25.00 **DIAMOND STATE EVERGREEN CO., Milton, Del.**

NATURAL PHOSPHATE ROCK Finely Ground. Florida 33%—Tenn. 30% 100 lb. to carload lots. Write for prices and literature. **L. M. BROBST, Phalanx Station, Ohio.**

RUHM'S 30% PHOSPHATE ROCK! Costs less to BUY the fine than to take the coarse ground **FREE! H. F. SCOTT, Dunville, Ont., Greenville County, Canada.**

FOUR LEAF POWDERED ROCK PHOSPHATE 30% There is no life without phosphorus for permanent soil improvement with phosphated legumes. Free information—price—and freight rate your station. **JOHN L. MARSON, R. 2, Pleasant Mount, Pa.**

BIORG ACTIVATOR really heats up your compost pile fast. Generous supply $1. **SCHIFF BIO FOODS, Jersey City, 3, N. J.**

MINERALIZED Organic Soil Builder — "CALSOIL" contains 20 minerals—blood meal—beef scraps—vegetable matter—bone meal—calcium—(no filler). 10 lbs. $1.20; 25 lbs. $2.50. Delivered price. Farm quantities for less. **NORTHERN FIELD SEED CO., Winona, Minn.**

HAMILTON COUNTY, OHIO. RUHM'S SUPERFINELY GROUND PHOSPHATE ROCK. Cheapest source of phosphorus. 24 Trace Elements. **FRED A. VEITH Cheviot P.O., Cincinnati 11, Ohio.**

EQUIPMENT

FANS—Portable, Special Built, for Hay and Grain Drying. Heat Units. Write for "The Key" to a more profitable feeding program. **FREE. WAYNE WYANT,** Factory Representative, **122 Sheridan Square, Pittsburgh 6, Pa.**

IRRIGATION EQUIPMENT — Immediate delivery of lightweight pipe. Complete systems, including pump, fittings and sprinklers. Featuring famous and exclusive McDowell automatic coupling and sprinkler that covers a little under 3 acres. **LUNDQUIST CO., Inc., Putnam, Conn.**

GOVERNMENT SURPLUS—200 Ampere, 28 Volt DC Generators, use for electric welding. $33.00 each. Free information. **LEWIS SHORT, Dept. OF, Burrton, Kansas.**

LOOK-UP—GET YOUR WEATHER FORECASTER only 10¢. Tells when it will rain or frost. Send today. **LIGHTNING SPEED MFG. CO., Box 115—O.F. Streator, Illinois.**

FEED SUPPLEMENT

DRIED and PULVERIZED BEEF SCRAP and BONE MEAL. 45% protein, 13% fat content. Excellent stock feed supplement or fertilizer ingredient. $8 per 100 lbs. Freight collect. **GULF-PRAIRIE CO., Box 4062, Corpus Christi, Texas.**

POULTRY

U.S. APPROVED PULLORUM PASSED CHICKS. Choose from twenty varieties including Dark Cornish, Anconas, Silver Wyandottes, Columbian Wyandottes, Buff Orpingtons. **RHODES HATCHERY, Box OF, Spencer, West Virginia.**

BANTAM BABY CHICKS. Hatching eggs. Large Light Brahmas and Black Leghorns. Pullorum Passed. From show winners. Circular. **EDWARD DURLING, RD 1, Princeton, New Jersey.**

NEW KEYSTONE White American and White African guinea eggs and chicks. Easily raised in confinement or range. No disease. Eat or market in 12 weeks. Send for new, informative circular. **MOLATTAN FARM, Box 320, Douglassville, Penna.**

GEESE

EARTHWORMS FOLLOW GEESE. Beautiful White Chinese Geese, six weeks old (need no housing). Three for $12, ten for $35. Immediate delivery. Will lay by spring. Heavy laying, prize winning stock. **RY-HIL FARM, Box O, Issue, Maryland.**

EARTHWORMS

DOMESTICATED EARTHWORMS are real investments to growers of small fruits, less work, more profits. **MRS. WM. J. GROTH, Chesterfield Worm Farm, Route 7, Richmond, Va.**

"HARNESSING THE EARTHWORM." Life story of the author, "An Earthworm Turned His Life," mailed free. Write **DR. THOS. J. BARRETT, Dept. 24, Sun Valley, Calif.**

MODEL BOX SETUP, including 600 mature SOILUTION earthworms, capsules and culture, $7.00. Prepaid. **FINE FOR BEGINNERS.** Breeders, 200—$2.00. Instructions. **NATURE'S SOIL BUILDERS, 1544 Spring Garden, Lakewood, Ohio.**

EARTHWORMS for Farm Production use. 15 Years Experience. Informative Circulars. Backed by Service. Most Reasonable Prices. No Failures Following Our Methods. **R. A. CALDWELL, Barwick, Georgia.**

GROWFAX worm food CONCENTRATE makes them GROW FASTER. Contains the famous "animal protein factor" of fish meal. Use diluted or to fortify less concentrated mesh. $1. **SCHIFF BIO, Jersey City, 3, N. J.** Ask for list.

FREE INSTRUCTIONS with 1000 domesticated red earthworms, mature breeders, $7.00 delivered U.S.A. Raise earthworms for SOILBUILDING, FISHBAIT, and solve your GARBAGE DISPOSAL problem. Order from **HOLLY-OAKS, Lloyd, Florida.**

FOR DOMESTICATED EARTHWORMS to build your garbage and waste materials into organic rich soil call or write **Mrs. L. JONES, 1515 E. 76th, Seattle, 5, Wash.**

HYBRID MATURE EARTHWORMS New England acclimated $5.00 per thousand delivered Fifth Zone. Interesting free circular on easy care and culture. **MERRYVALE FARM, R. 3, Brattleboro, Vermont.**

TO OBTAIN the most from your soil, use **Earthworms.** Folder and new special offer sent on request. **EDMONDSON HATCHERY, 115 Mirabeau St., Greenfield, Ohio.**

LIVESTOCK

FEEDER CATTLE, Whitefaces—Best from the West. Priced right. Several sizes. One head or a carload. Free delivery on quantities. **O. V. DOELL, Canandaigua, N. Y.**

FIVE HUNDRED REGISTERED HOGS, eleven breeds, all sizes, winners W. Va. State Fair. Brown Swiss Cattle Dorset. Hampshire Sheep. Fancy Poultry. **EVERHART FARMS, Kearneyville, W. Va.**

BERKSHIRES—Weanling Pigs, Service Age Boars shipped by railway express in crates. Send for free leaflet, "Parade of Champions", price. **MIAMI FARM, R. R. 1, Peru, Indiana.**

SILOS

PORTLAND wet-mixed concrete stave silos not excelled in quality, conveniences, durability. Sold direct. Get particulars. **PORTLAND SILO CO., Box 8110, Portland, Indiana.**

IRISH WOOLENS

THIN SUMMER BLANKETS, extraordinarily beautiful. HANDWOVEN IN IRELAND, 100% new wool. Washable. Thicker ones too; and tweeds. **CAROL BROWN, Putney 54, Vt.**

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STRAWBERRY PLANTS less than 2¢ each 2 yr. cult. Blueberry plants 34¢ each. Write for free leaflet. **COMMONFIELDS NURSERIES, Mitchell Rd., Ipswich, Mass.**

VEGETABLE Plants and Flower Plants of all kinds. Organically grown. $2.25 per hundred postpaid. **MILLER'S VEGETABLE FARM, Bellville, Ohio.**

PINK SKIN PORTO RICOS. Big, strong, well rooted plants, grown in open sunshine. Vigorous plants live better. 200—$1.00; 500—$1.50; 1,000—$2.45; 5,000—$12.00. **J. C. DELLINGER, Gleason, Tennessee.**

POTATO PLANTS: NANCY HALLS . . . PORTO-RICANS 200, $1.00; 500, $1.50; 800, $2.25; 1,000, $2.50; 2,000, $4.75; 3,000, $7.50; 4,000, $9.00; 5,000, $11.00. Write for wholesale prices on larger amounts "Twenty years experience in growing plants." (We grow 'em here—they grow for you there.) **WILLIAMS' PLANT FARM, Gleason, Tennessee.**

DOGS

PUREBRED BORDER COLLIE PUPS, the most willing workers with livestock. Sired by imported Tops, son of British Champion Spot. **ELI STOLTZFUS, R. 2, Elverson, Pennsylvania.**

REGISTERED ENGLISH SHEPHERD PUPS. Five months old. Starting to drive cows now. Make good watch dogs and companions. $25.00 each. **JULIA STRITTMATTER, Sewell, New Jersey.**

BOOKS AND PUBLICATIONS

"MIRACLES OF MENTAL ACTION." Exceedingly vital, valuable information. Tremendously useful. Price $1.00. **SATISFACTION GUARANTEED. SCIENTIFIC INFORMATION SERVICE, 2259 Houghton Ave., SC, New York City 61.**

"CONCRETE BLOCK HOMES" 32 page booklet with instructions on how to build. $1.00. **"CONCRETE BLOCK GARAGES"** booklet $1.00. **H. C. LIGHTFOOT, Civil Engineer, Richboro 18, Penna.**

FOODS

PURE Delicious Mountain Sage Honey. (Sprayfree). 12 lbs. $3.95. 4 lbs. comb honey $2.50. Sun-dried apricots (unsulphured) 5 lbs. $3.00 **PREPAID.** Add 15% to order outside California. **TONTZ HONEY FARM, Lake Elsinore, Calif.**

SALTMARSH'S APPLE SYRUP. Made from the fresh juice of New England apples and granulated sugar, boiled down to a rich golden syrup with the most delicious flavor you ever tasted. Preferred by hundreds to Maple Syrup. Delicious on waffles, pancakes, etc. **SALTMARSH'S CIDER MILL, New Boston, N. H.**

UNPROCESSED, UNSULPHURED, SUN-DRIED FRUITS, not sprayed or chemically fertilized, 10 lb. boxes: Peaches $3.40, Pears $3.60, Black Mission Figs $2.60. White Calimyrna Figs $3.60, Assorted $3.50. **ALSO:** Raw, unprocessed Fruit Nut Cake, 5 lbs. $3.95. Tree-ripened natural Dates, 5 lbs. $1.75. Plump, select, Shelled Almonds, 5 lbs. $3.75. Raw Cashews, 5 lbs. $3.95. Unheated, unrefined, California Virgin Olive Oil, gallon $4.50. Please remit with order. Express collected on arrival. **S. H. JAFFE (E) Lakeside, California.**

PURE, DELICIOUS HONEY Raspberry Blend. 60 lbs. $9.00 not prepaid; 5 lbs. $1.60 prepaid. Same price for unheated naturally crystallized. **FRANK FEKEL, Rt. 6, Vineland, N. J.**

PHOTO FINISHING

EIGHT LIFE PRINTS eight exposure roll 25¢, twelve exposure roll 35¢, jumbo prints add 10¢ roll. Reprints 3¢, jumbo reprints 4¢. **LIFE STUDIOS, Onalaska, Wisconsin.**

BEAUTIFUL 8x10 ENLARGEMENTS Of Your Favorite Snapshots. Suitable for framing. 3 for $1.00. Send negatives with remittance. **WILLIS SHOOK, Sewickley, 3, Pa.**

SOIL TESTING

BETTER CROPS, BETTER LAND, BETTER INCOME through reliable laboratory soil analysis and experienced recommendations. $3.50 per sample. Send for sampling instructions and mailing tubes. **EDWIN HARRINGTON,** Agricultural Chemist, **Carversville, Pa.**

FOR SALE

LADY with forty head select cattle, mostly prize winning Milking Shorthorns, wishes to expand and relocate in South Central Milk Market section, and sell part interest to good organic farmer, who will act as manager. **BOX 224, Franklinville, New York.**

FOR SALE, Lease or open to proposition to operate. Seventeen acres sandy loam. Two miles south, Cambridge, Maryland, main highway. Opportunity roadside business. Two acres young bearing fruit trees, ample organic material available. Have other business interest. **BOX 102, Mamaroneck, N. Y.**

IMPROVED BOTTOMLAND FARM, 84½ acres in Northern Missouri with 44 in bluegrass pasture, 11 in oats, 10 in soy beans, and 6 in corn. Three young horses, 3 milk cows and full line of machinery. Hard road, electric light, bus service, excellent grade and high school facilities. Two miles to store and church. Price—$5,300 on cash, take all provision. All letters answered. **O. L. RUSSELL, Clifton Hill, Mo.**

MISCELLANEOUS

10 x 28 new TRACTOR TIRES $35.00. Other sizes in proportion. Send for list covering makes, sizes and prices to **DUMBAULD'S TIRE SERVICE, Somerset, Pa.**

UNIQUE INFORMAL STATIONERY. Twenty original drawings by 20 artists of Lehigh Valley. Fitting for all purposes. Size 3" x 4". Postpaid $1.25 **MRS. WILLIAM H. STEUGERWALD, 213 S. 17th St., Allentown, Pa.**

DRAIN TILE—Perforated or plain—Good quality all shale "Bosco" grade. Carloads. Write for our Farm Drainage Handbook. **The BOWERSTON SHALE COMPANY, Bowerston, Ohio.**

STORAGE CELLARS—GRAIN SILOS. We furnish Master Plans & Specifications. You can build them yourself! Prevent losses, save precious crops, make more profits. Information on all storage problems. **FRANK D. STEINER, C.E., 182 Baldwin Ave., Baldwin, N. Y.**

BUDD'S FARM KING WORK SHOES. Built to withstand strain, exposure and rough wear of the farm. Retan leather uppers with rubber composition soles. all sizes. $4.98 add 15¢ for postage, no C.O.D.'s. **BUDD'S GOOD SHOES, Somerset, Pa.**

BUSINESS OPPORTUNITIES

ENERGETIC, healthy, middle-aged couple desires joining couple with real subsistence homestead (Eastern Seaboard States, not near urban centers); cooperatively working with them and supplying some capital. Separate unfurnished housing preferred. Write Box E. L. ORGANIC FARMER, Emmaus, Pa.

ORGANIC TRADING POST

ORGANICALLY GROWN California Valencia Oranges. $3.00 Per Box F.O.B. ALBERT E. LESLE 14545 E. Whittier Blvd., Whittier, Calif.

PREMIUM QUALITY Valencia Oranges Juicy Ripe. Cultured with humus, minerals, vitamins, hormones and beneficial bacteria. No chemicals used last five years. No poison spray. Nutritional content Certified by Spectrogragh and other laboratory tests which prove superior healthful qualities. Our Valencias awarded 1st, 2nd, 3rd, and Citrus Sweepstakes at Orange County Fair 1949. Californians may order from this adv. No. 1 size (16-17 lb.) $2.35; No. 2 size (32-34 lb.) $4.25 delivery prepaid in Calif. Others please write for descriptive folder with prices. DR. A. P. KOENTOPP, 1010 North Broadway, Santa Ana, Calif.

PURE VERMONT MAPLE SYRUP. Excellent flavor organically produced on our farm. Gallon, $5.95; ½ gallon, $3.40; quart $1.95 Postpaid. JOHN BACON, Johnson, Vt.

OH HONEY. Sun River, Montana. Extracted raw—no heat or chemicals. 5 lbs.—$1.75; 10 lbs.—$3.50. F.O.B. Sun River.

CALIFORNIA WHOLE SUNDRIED APRICOTS—Organically grown, unsulphured, unsprayed, tree-ripened, sundried. Minimum 10 pounds $4.80, shipped anywhere in the U.S. express prepaid. B. & J. FRUIT RANCH, 187 N. Halcyon Road, Arroyo Grande, California.

CLASSIFIED AD RATES FOR THE ORGANIC FARMER

Rates are 8c a word.

Minimum, 25 words, or $2.00

Payable in advance. Include name and address in word count.

Hybrid Earthworms

EARTHWORM CULTURE (eggs, worms and castings) builds and conditions soil, no other fertilizer needed, no hand-turning of compost. They multiply rapidly. DO NOT MIGRATE. Better health for plants and man. Send $1.50 for 100, $15.00 for 1800. Additional savings on larger amounts. FREE information on request. Full instructions with each order.

SUNSET ACRES, GOLD HILL, OREGON

FARMER WANTED

for 100 acre general farm in New Jersey. Modern barn, chicken houses and machinery. New owner changing to organic basis immediately. Four-room house, all improvements. State qualifications and salary expected in first letter. Write to Box O6F.

THE ORGANIC FARMER
Emmaus, Pa.

QUALITY FRENCH PRUNES

Health food—unprocessed—tree run sizes—no chemicals or commercial fertilizers—full of sugar—distinctive flavor—larger and better—30c per pound in minimum ten pound lots or more—charges *prepaid* anywhere in U. S. A.—no C.O.D.'s.

A. C. MARSH
926 Shannon Road Los Gatos 3, Calif.

WELLS TESTED

Chemical and Bacteriological analysis of water, feeds, fertilizers, soils, fuel paint, etc. Send for Folder C.

SKINNER & SHERMAN, INC.
246 Stuart Street, Boston 16, Mass.
NEW ENGLAND'S OLDEST AND LARGEST ANALYTICAL LABORATORY

200 Years of Organic Farming

(*Continued from page* 13)

and cattle was best for this purpose. Since he could not turn to an agricultural experiment station for advice, he had to do his own experimenting which he did on a field scale as well as on a box scale. He tried out various powdered stones and plaster of paris as fertilizers, sowed clover, guinea grass and orchard grass and obtained a scow for reclaiming silt from the bottom of the Potomac.

Even two hundred years ago Washington was concerned about "the growing poverty of the soil" and devoted much thought and action to restoring it. He believed in the liberal use of manure, but his supply was too limited for his thousands of acres. He used clover as a soil builder, but felt that the results were too slow and was long obsessed with the idea that the rich fertility of river mud was the answer to quick replenishment of the soil. The only obstacles were the difficulty and expense of dredging and spreading this material with the crude equipment available—scow and bucket, cart and pitchfork.

Not only did Washington try plowing under rye cover crops, but he experimented with various vegetables as cover crops which were supposed to be "strengthening to the land"—such as carrots and Eastern Shore peas—and also tried rib grass and burnet. Strip cropping was also resorted to by Washington (another "modern" agricultural practice) for he planted corn in rows ten feet apart and grew potatoes, carrots and peas in the spaces. He was an early advocate of the idea that the best seeds will produce the best crops and found by trial that even these produce better on dunged than undunged land, using two hundred bushels of manure to the acre in his experiment. I have found by loading my truck with bushel baskets of manure, that about fifty bushels of manure of average moisture make approximately one ton, so Washington was using a light dressing of only four tons to the acre.

Farm Help

It's a problem for any organic farmer, in hiring help, to find men who understand the natural way of farming, or the work of years can quickly be undone by reverting to "scientific" methods. Washington, too, had this problem, for he wrote when he was seeking a farm manager who would be: "Above all, Midas-like, one who can convert everything he touches into manure as the first transmutation toward gold; in a word, one who can bring worn-out and gullied lands into good tilth in the shortest time. Unless some such practice as this prevails my fields will be growing worse and worse every year until the crops will not defray the expense of the culture of them."

A Startling Concept

As we have seen, Washington had many a modern agricultural idea and practice, but most startling of all was his concept of our everlasting sources of fertility, best expressed in his own words: "While, therefore, I allow, in its full extent, the value of stable manure, marl, plaster of paris, lime, ashes, sea weed, sea shells and salt, in enriching land, I believe none of them are absolutely necessary and that nature has provided an inexhaustible store of manure, which is equally accessible to the rich and poor which may be collected and applied to the land with very little labor and experience. This store is the atmosphere and the process by which the fertilizing substance may be obtained is vegetation."

And he went on to say, indeed to repeat, that cover crops such as buckwheat, beans, peas and oats should be turned under to decay and that soil should never be left bare.

Is it not conceivable that the father of our country might also be called the father of modern organic farming?

Grow Your Fences

Multiflora rose will make a low cost living livestock enclosure.

By BENJAMIN MANZ

A HEDGE fence with a lower cost than woven wire fencing, and without "upkeep" is the Thorny Multiflora Rose. And you don't have to trim it, a job which cost the popularity of the osage hedges. On farms without livestock it can be utilized as a field marker, especially on contoured lands, and in food and cover plantings for wildlife.

The plants can be obtained from nurseries, sometimes state nurseries. Some states are giving them in small numbers to farmers in efforts to encourage game. Seeds can also be purchased, but be sure to follow directions carefully if you intend to start plants.

Plant single rows of the plants one foot apart for fences, farther apart if for markers only. A slit can be made with a spade or shovel, the plant inserted, and the hole tamped well shut. Some spring planting in the past has been done on fall plowed land. It would be an improvement over this to fall plow, making sure to destroy existing vegetation, and then to sheet compost. The land would then be in good condition for spring planting. The fence will, under favorable conditions, be ready to hold stock (except small pigs and chickens) in four or five years. Until then it should be protected from grazing animals. Cultivation should be practiced for at least one year to give the plants a head start on weeds.

Another method that might work in small areas would be to mulch before planting. This would eliminate cultivation, but would require a large amount of mulch material.

A rose fence around a wood lot would be especially desirable. Here it would not only keep stock out, but serve as a windbreak to the forest floor and provide winter fruits, food for birds which are beneficial to both farm and forest. Hedges in England are a recognized protection against erosion. We need them in America to encourage birds for insect control also.

If it is desired to destroy such a fence row, clipping will do the job.

Information on sources of plants and culture can be obtained from your state conservation department.

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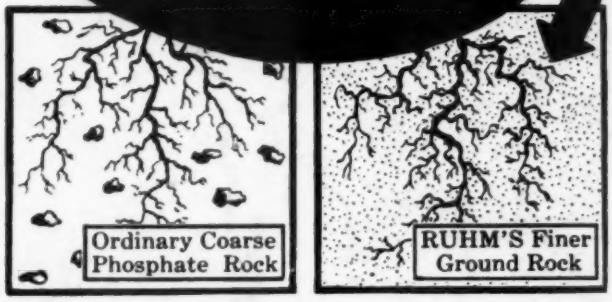

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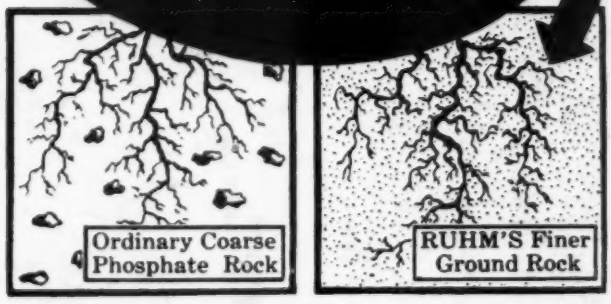

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